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HYDROUSA

H2020-CIRC-2-2017

Water in the context of circular economy

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

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User requirements and specifications definition

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Brief Description	The current document contains the results of the user requirements surveys that were conducted in the test sites of the HYDROUSA, as well as at the 2nd Management Meeting of the project in Nice for helping in the development of the HYDROUSA platform. The theory and the methodology that was used for eliciting user requirements are also analysed. This report is the first version of the user requirements and specifications. Co-creation activities will be conducted in the forthcoming months for fine-tuning the user requirements and specifications, and will be reported on D5.3 "Updated user requirements and specifications definition" (M21).
Keywords	User Requirements; Stakeholder Interviews; Focus Group

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EXECUTIVE SUMMARY

The aim of this deliverable was to define the user requirements and specifications for the monitoring of the HYDROUSA demonstration sites using Information and Communication Technologies (ICT). The elicitation of user requirements and specifications was conducted by the different stakeholder perspective, for completing one of HYDROUSA project main objectives, which is the creation of resilient and attractive long-lasting systems through the combination of skilled workmanship with modern ICT solutions.

The current document contains the activities that were conducted during T5.2 (Users requirements and specifications definition for monitoring and controlling). Specifically, the document provides the importance of user requirements and specifications, the methodology that was used to carry out the survey and the results of this process.

Both research interviews and focus group discussions were employed with HYDROUSA stakeholders from the different demonstration sites (HYDROs) for the elicitation of user requirements. Questions included, among others: the ICT infrastructure that is needed by each stakeholder (e.g. sensors, communication protocols), the kind of information they require from the platform, the way that they prefer to interact with the platform, etc.

The collected data were analysed using both qualitative and quantitative techniques for ensuring precision, reliability and integrity of the results. Outcome of this procedure was the definition of the user requirements for each HYDRO in terms of software and hardware in order to be implemented in the HYDROUSA project (Task 5.6).

Therefore, this deliverable comprises an initial description of the defined user requirements for each HYDRO that it will be updated in the D5.3 - Updated user requirements and specifications definition (Month 21).

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ABBREVIATIONS

3G	Third generation of broadband cellular network technology
4G	Fourth generation of broadband cellular network technology
AERIS	AERIS Tecnologias Ambientales S.L.
AGENSO	Agricultural and Environmental Solutions
ALCN	alchemia-nova GmbH
BOD	Biochemical Oxygen Demand
CH_4	Methane
COD	Chemical Oxygen Demand
CW	Constructed Wetland
DO	Dissolved Oxygen
ELT	Tinos Ecolodge
GUI	Graphical User Interphase
GSM	Global System for Mobile communications
HRT	Hydraulic Retention Time
ICRA	Catalan Institute for Water Research
IHA	Impact Hub Athens
JAD	Joint Application Development
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
MFA	Material Flow Analysis
NTUA	National Technical University of Athens
RAD	Rapid Application Development
TSS	Total Suspended Solids
UASB	Upflow Anaerobic Sludge Blanket
UNIVPM	Università Politecnica delle Marche
UV	Ultra Violet
WW	Wastewater

1. INTRODUCTION

The main aim of this task was to identify the requirements, from the user perspective, in order to complete the objective of HYDROUSA, which is the demonstration of innovative solutions for water/wastewater treatment and management. The final goal is to identify user requirements and map them into building the monitoring controlling capabilities of the HYDROUSA integrated platform. Subsequently, two different surveys were conducted at September 2018 and February 2019.

Understanding the user requirements is an integral part of information systems designs and is critical to the success of interactive systems. It is widely understood that successful programs begin with an understanding of the needs and requirements of the users (Maguire and Bevan, 2002). User requirements analysis provides precise descriptions of the content, functionality and quality demanded by prospective users. The benefits of this approach can include increased productivity, enhanced quality of work, reductions in support and training costs, and improved user satisfaction (Maguire and Bevan, 2002). In general, user requirements identification follows several steps and it can be done with different methodologies. In order to have accurate information and fulfil their requirements, an analysis implies interaction with stakeholders.

User involvement, through the user-centred design methodology is a widely accepted principle in the development of usable systems (Gould and Lewis 1985; Karat 1997). According to Kujala (2003), user involvement has generally positive effects on the early activities in the development process, especially on user satisfaction. In addition, taking users as a primary information source is an effective mean of requirements capture. Based on the aforementioned, it is generally agreed that increased usability is achieved through the involvement of potential users in the system design especially through early stage and continuous involvement.

However, it is necessary to think carefully about who the users are, and how to involve them in the design process at the beginning of every user requirement study. Listening to users' discussions, the alternative designs can amplify designers understanding on the intended purposes of the artefacts and may provide information that does not come out from initial interviews, observations and needs analysis. Specifically, for the user requirements elicitation process on computer technology systems, a major advantage of the user-centred design approach is that a deeper understanding of the psychological, organizational, social and ergonomic factors that affect the use of computer technology emerges from the involvement of users at every stage of the design and evaluation of the product. The involvement of users assures that the product will be suitable for its intended purpose in the environment in which it will be used. Thus, this approach leads to the development of products that are more effective, efficient and safe. It also helps designers manage user's expectations on a new product. When users have been involved in the design of a product, they know from an early stage what to expect from it and they feel that their ideas and suggestions have been taken into account during the process (Abras, et. al, 2004). This leads to a sense of ownership for the final product that often results in higher customer satisfaction and smoother integration of the product into the environment (Preece, et. al, 2002).

The selection of the most appropriate method or methods that can also fit in organizational context is a difficult task. According to the means of communication, there are four types of user requirements elicitation methods. These are the observational, the conversational, the analytic and the synthetic category. Each category presents a specific interaction model between analysts and stakeholders and reflects the nature of method manuscripts must be in English (Umber, et. al, 2012). A more detailed analysis of each category is provided below:

A) **Conversational category**: The conversational category methods provide means of verbal communication between two or more people. Verbal methods are also included in this category. Specifically, verbal methods such as interviews, workshops, brainstorming, focus group interviews are used in an extraordinary variety of domains, and are often quite successful. Conductor of these interviews is an experienced analyst with generic knowledge about the Application domain. The analyst discusses the desired product with different groups of people and builds up an understanding of their requirements. If the interview is conducted with pre-defined agenda and questions, it is called structured interview; otherwise it is an open-ended interview.

B) **Observational category**: The observational category methods provide the source to create a rich understanding of the application domain by observing human activities (Zhang, 2005). In addition to non-tacit requirements, some requirements are apparent to stakeholders, but difficult to verbalize. These are called tacit requirements (Goguen and Linde, 1993). Verbal communication is often helpless when collecting tacit requirements. Therefore, observing how people do their daily work helps in acquisition of information, which are hard to verbalize. The routine works that people perform daily in an intuitive way and the organizational or social contexts affect the requirements. As people are familiar with the context and situation of their work, they do not consciously think about the routine and the working environment. It is difficult for them to explain how work is done, although the routine work sometimes is easy to show to others.

C) **Analytic category**: The analytic category methods provide ways to prospect the existing documentation or knowledge and procure requirements from a series of speculation. Some methods under this category are the requirement reuse, the documentation studies/content analysis, the laddering and the card sorting (Zhang, 2005). In the requirement reuse category, there is a reuse of glossaries and specifications of legacy systems or systems within the same product family to identify requirements of the desired system involved. Domain requirements, user interface characteristics, organizational policies, standards, legislation etc., are taken into consideration in requirement reuse, while the content analysis is a common method consisting of reading and studying available documentation for content that is relevant to and useful on the requirements elicitation tasks. At the content analysis category organizational policies, standards, legislation, market information and specification of legacy systems are used to identify the need of the end-users of a product/service.

D) **Synthetic category**: The synthetic category method forms a coherent approach by systematically combining conversation, observation, and analysis into single a method instead of combination of individual methods. These are also called collaborative methods. The synthetic category includes methods such as Scenarios, Passive Storyboards, Prototyping, Interactive storyboards, Joint Application Development (JAD)/Rapid Application Development (RAD) sessions, Contextual inquiry. More specifically, the scenario is an interaction session that describes a sequence of actions and events for a specific case of some generic task, which the system is intended to accomplish. Prototyping, interactive storyboards provides stakeholders with a concrete (although partial) model or system that they might expect to be delivered at the end of a project. The latter are often used to elicit and validate system requirements. JAD/RAD methods emphasize on user involvement through group sessions with unbiased facilitator and have become popular in Requirements Engineering (Mead, 2006). This method is very close to focus groups. Contextual inquiry is a combination of open-ended interview, workplace observation, and prototyping. This method is primarily used for interactive systems design where user interface design is critical.

In addition, some other factors must be taken under consideration when selecting any elicitation method. These factors are presented mainly under four perspectives. Namely, i) abstraction level of requirements; ii) requirements source; iii) communication obstacles; and iv) level of certainty. In different cases different elicitation approaches shall be applied because requirements resource is closely related to the communication environment and the various test cases. Stakeholders articulate the sources of requirements. Therefore, the source of requirements exists in different forms such as knowledge embedded in human being and the knowledge embedded in the physical environments. The user requirements engineer shall ensure that the selected method can effectively utilize the requirements sources in terms of data availability and knowledge acquisition process. To achieve this, it is important when selecting a method, that the requirements analysts have a good knowledge about the application domain, in order to avoid problems that might emerge. Finally, the level of uncertainty is relatively very low with conversational methods (e.g. interviews) or some synthetic methods (e.g. evolutionary prototyping) (Umber, et. al, 2012).

There are three basic uses of this methodology:

A) They are used **as self-contained** method in studies in which they serve as the principal source of qualitative data, just as participant observation or individual interviewing. Using focus groups in this manner requires a careful matching of the goals of the research with the data that the focus groups can produce to meet these goals. Accordingly, the use of focus groups as a self-contained method often leads to an emphasis on research design.

B) They can be used as **supplementary source** of preliminary data in studies that rely on some other primary method such as survey. For example, they can be used to generate survey questionnaires or to develop the content of applied programs and interventions. The focus groups could also serve as a source of follow-up data to assist the primary method. For instance, they might be used to pursue poorly understood survey results or to evaluate the outcome of a program or intervention. In these supplementary uses of focus groups, the groups must be set up and conducted in ways that maximize their value for the primary method.

C) Third, they are used in **multi-method** studies that combine two or more means of data gathering in which no one primary method determines the use of the others. In these combined uses of qualitative methods, the goal is to use each method so that it contributes something unique to the researcher's understanding of the phenomenon under study. The relative place of focus groups within this mix of methods would depend on the researcher's data needs, the opportunities and limitations of the field setting, and so on (Morgan, 1996).

They are guided and directed by a moderator, but they are driven by the participants and can provide in depth analysis by the interaction between experts.

2. USER REQUIREMENTS METHODOLOGY

The main objective of HYDROUSA project is to develop a globally accepted and easily adaptable set of circular nature-based solutions for the water supply and the wastewater problems that high touristic places usually face. This will be achieved through ICT enabled monitoring and control. Specifically, sensors, controllers and actuators will be deployed for monitoring and controlling important parameters in the different demonstration sites. In each demonstration site, the so-called HYDRO site, different water and wastewater treatment systems will be developed, resulting in different user requirements and specifications for each site.

Nowadays, Information and Communication Technologies (ICT) can provide efficient water management in different cases like irrigation (Sne, 2005) and water monitoring (Sempere-Payá et al., 2013). However, the success of any ICT integration in any process is defined on how well it suits its purpose and meets the needs of the intended users. For this reason, the involvement of users is needed to identify the user requirements (Brownsell et al., 2012).

Therefore, to identify them in the HYDROUSA project, a synthetic approach was followed, which included stakeholder profile analysis, initial demo sites analysis, stakeholder interviews in each HYDRO site (six demonstration sites in total) and a focus group discussion with all stakeholders in the second management meeting at Nice. The aim of this methodology was to derive both in depth and in breadth the initial requirements and specifications of each HYDRO site.

Stakeholder profile analysis was used for the identification and prioritization of each stakeholder group interests (Slabá, 2016), while the initial demo sites analysis along with each demo site description were used for understanding each HYDRO's aim, and identify the dependencies between different requirements and specifications of each HYDRO. This is important in user requirements elicitation processes in order to achieve proper software and hardware development (Zhang et al., 2014). Interviews with stakeholders was chosen as a method in the HYDROUSA user requirements elicitation process because this method is one of the most common methods in user requirements elicitation, as it provides an in-depth information. Personal interviews are divided into structured interviews (questions with multiple choice answers), semi-structured interviews (questions with a mix of predefined answers and open answers), and unstructured interviews (only open questions that the interviewee can answer in whatever way he/she likes) (Burnay et al., 2014). Focus group survey, which can be defined as a research technique that collects data through group interaction on a topic determined by the researcher, was used due to the broad analysis that it offers (Morgan, 1996).

2.1 Stakeholders Profile

Stakeholder analysis is described as the analysis that identifies, for each user and target group, their main roles, responsibilities and task goals in relation to the system (Maguire, 2001).

At user requirements identification, all relevant stakeholders were engaged. Namely, the stakeholders involved in HYDROUSA consist of municipalities and water utilities, farmers and their associations, SMEs, eco-tourist facilities, consumers and tourists. A brief description of each stakeholder group is presented below.

Municipalities usually are single administrative divisions having corporate status and powers of self-governance or jurisdiction as granted by national and regional laws to which it is subordinate. It is to be distinguished from the country, which may encompass rural territory or numerous small communities such as towns, villages and hamlets.

Water utilities are organisations responsible for the water and wastewater management including water abstraction - treatment and distribution, as well as waste water collection – treatment and disposal or reuse.

Farmers are the owners of agricultural holdings, characterized by distinctive common measurable features, such as the utilized agricultural area (UAA), the amount of labour input, the level of self-consumption and the economic size of the farm.

Farmers' associations enabling the self-provisioning of economic actors with goods and services whose delivery is precluded by the constraints on the social division labour. Farmers associations are controlling a 50% share in the supply of agricultural inputs (Tortia et al., 2013). According to FAO farmers; association's role is to facilitate small farmers' access to: natural resources, information, communication and knowledge, markets, food and productive assets, policy-and decision making.

Small Medium Enterprises (SMEs) are small and medium-sized enterprises, small businesses whose personnel numbers fall below certain limits. The main factors determining whether an enterprise is an SME are the staff headcount, either turnover or balance sheet total. A medium sized company has less than 250 employees, owns a turnover of ≤ € 50 m or a balance sheet total ≤ € 43 m. For the small company category there are < 50 employees, ≤ € 10 m turnover or balance sheet total.

Eco-tourist facilities: Generally, ecotourism deals with interaction with biotic components of the natural environments. Ecotourism typically involves travel to destinations where flora, fauna, and cultural heritage are the primary attractions. It is intended to offer tourists an insight into the impact of human beings on the environment and to foster a greater appreciation of our natural habitats. Therefore, in addition to evaluating environmental and cultural factors, an integral part of ecotourism is the promotion of recycling, energy efficiency, water conservation, and creation of economic opportunities for local communities. Eco-tourist facilities are consisted of eco-friendly systems like water recycle systems and solar energy use.

HYDROUSAs' main stakeholders were divided into 2 categories:

A) Advanced stakeholders: including stakeholders that require specialized materials, like measurements, monitoring etc. In this category belong municipalities and water utilities, SME's and farmers associations.
B) Non-Advanced stakeholders: farmers, eco- and agro-tourism, consumers and tourists belong to this category. This kind of stakeholders do not require extensive information about measurements. Irrigation of the fields and water supply were the most important parameters for these stakeholders.

The community will be engaged in co-creation processes in the demo islands, one forming new eco-tourism business models, another designing the agroforestry system with local crops and plan communities and further citizen-science activities, and one for the setup of the user requirements in the ICT control system and the game development. The municipalities from all pilot and all early adopter sites will be involved, while the community will be informed about circular economy facts.

2.2 HYDRO Sites Description

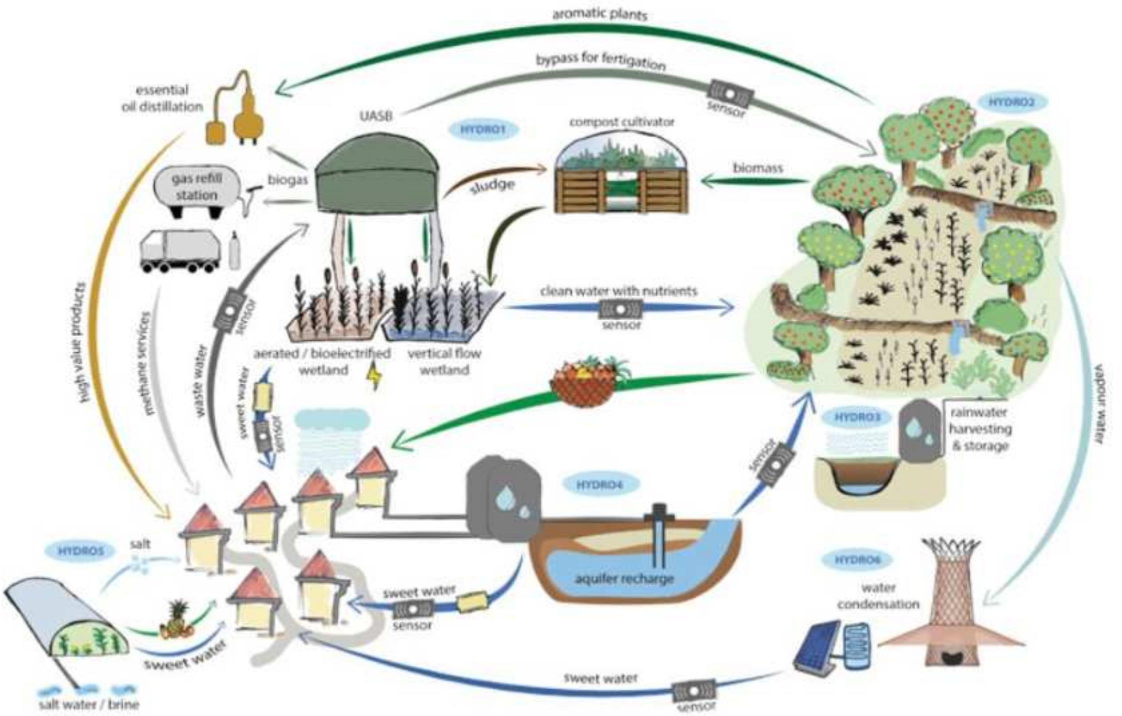

Figure 2.1: The complete system of HYDROUSA project

For the needs of HYDROUSA project, six different demonstration sites, called HYDRO sites, were chosen for the development of the systems in three Greek islands (namely Lesvos, Mykonos and Tinos) that face water scarcity issues. Each of these HYDRO sites has different needs of sensors, monitoring equipment, type of irrigation system, while every system operates differently. Each HYDRO site should demonstrate different solutions for mitigating the water scarcity problems. Based on the aforementioned, it was mandatory to understand each HYDRO's aim before continuing to the requirements and specifications analysis. Thus, a brief description of each HYDRO site is presented below.

<u>HYDRO 1 Antissa, Lesvos</u>

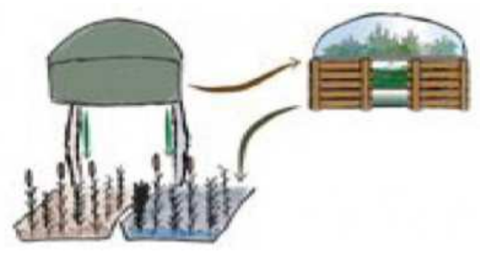

Figure 2.2: Schematic presentation of water treatment system in HYDRO 1

The first demonstration area HYDRO 1 is established in Antissa, Lesvos Island. A sewage treatment system will be developed to treat wastewater at appropriate standards to allow reuse. Specifically, the Upflow Anaerobic Sludge Blanket Reactor (UASB) technology will be applied, in which biogas will be produced and upgraded to methane for the valorisation as a fuel. Three constructed wetland (CW) systems will be established in parallel as post treatment of the UASB effluent. Here, no wastewater will be discharged, while cheaper production of reclaimed water will be attained, increasing the water supply and recycling nutrients available in the treated wastewater to the

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crops. A schematic of the installation of the different components of HYDRO 1 is presented in Figure 2.2 and Figure 2.3.

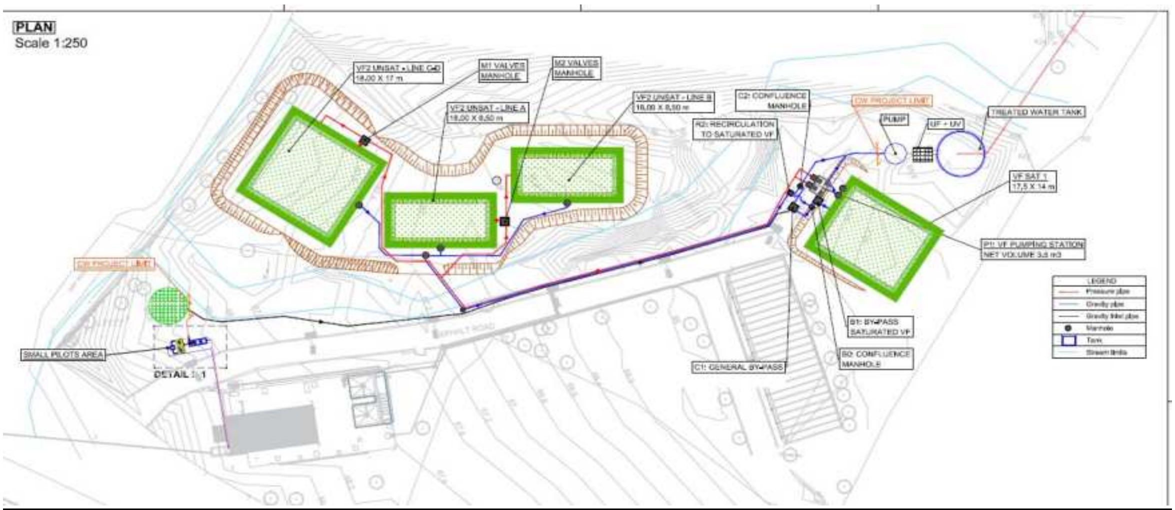

Figure 2.3: HYDRO 1 set up of the system

HYDRO 2 Antissa, Lesvos

HYDRO 2 is also established in Lesvos Island. The water of this system will be nutrient-rich and it will be applied to 1 ha of land where an agroforestry will be developed. Forestry trees for fruit and timber production, orchards/bushes and herbs together with annual crops will be cultivated. Also, goji berries and aromatic plants will be planted and utilized for essential oil production. While, the treated wastewater produced in HYDRO 1 will be used for fertigation (Figure 2.4 and Figure 2.5).

Figure 2.4: Schematic presentation of the experimental field in HYDRO 2

Figure 2.5: Schematic presentation of the HYDRO 2 demo site

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HYDRO 3 Ano Mera, Mykonos

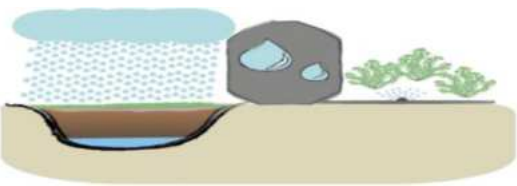

Figure 2.6: The sub-surface system of HYDRO 3

At the third demo site in Mykonos (HYDRO 3), an innovative rainwater harvesting system will be implemented in a remote area without house roofs. Rainwater will be collected with a sub-surface collection system. This water will be used to irrigate 0.4 ha of oregano. This cultivar was selected because of its low water demands. The cultivars will receive the required amount of nutrients through composting of green material available on site (Figure 2.6 and Figure 2.7).

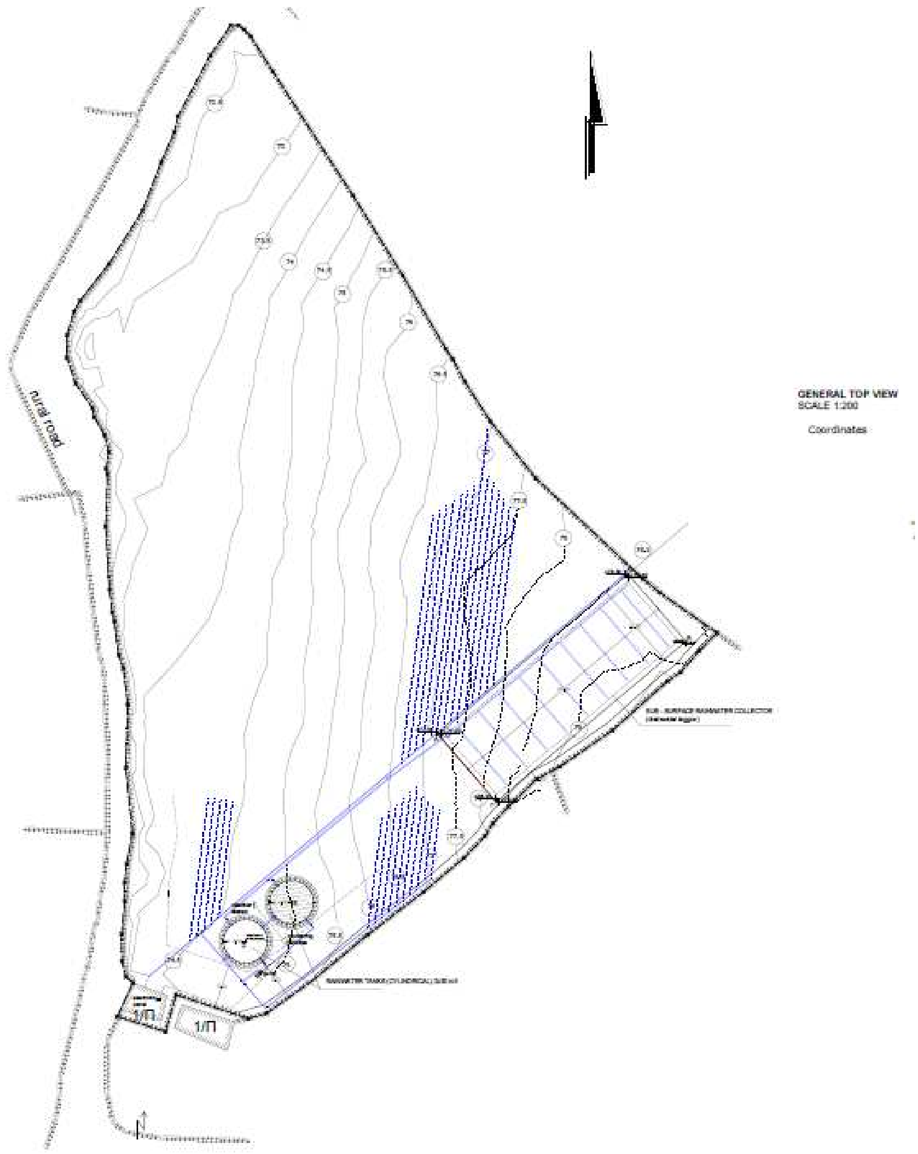

Figure 2.7: Schematic presentation of the area and the demo site at HYDRO 3

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HYDRO 4 Ano Mera, Mykonos

At HYDRO 4 site, a rainwater harvesting system of domestic residences which already exists will be upgraded through the HYDROUSA project. Domestic rainwater and surface runoff will be harvested, stored into the aquifer and used to water a lavender field. This system will also produce potable water by treating rainwater through a slow sand filtration unit. With this system the problem of salinization can be reduced. Then the water will be used to irrigate a 0.2 ha of lavender and nutrients will be provided in the same way as in HYDRO 3 with oregano, through composting greens available on-site. Lavender is popular for its essential oils and this is the reason that is was selected. The area has also many stones that will be used to distribute water channels (Figure 2.8 and Figure 2.9).

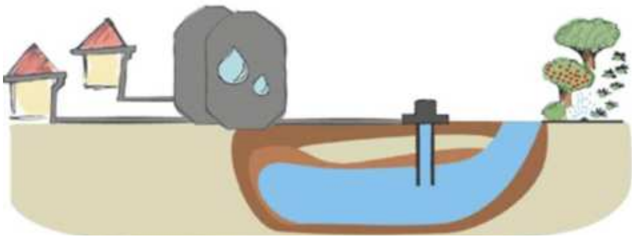

Figure 2.8: The domestic rainwater harvesting system in HYDRO 4

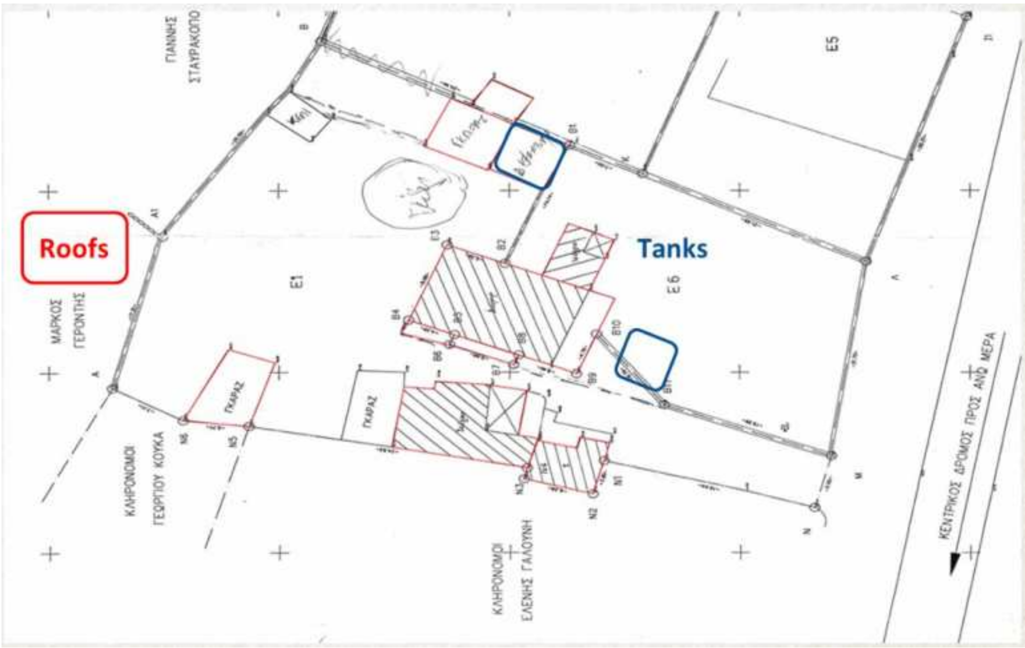

Figure 2.9: Set – up of HYDRO 4 demo site

HYDRO 5 Agios Fokas, Tinos

At HYDRO 5 seawater and brine from the existing desalination plant will be treated in a Mangrove Still unit coupled to a tropical greenhouse to produce clean water via evaporation and condensation, edible salt and tropical fruits. So sweet water can be produced from saltwater and at the same time produce tropical fruits and salt (Figure 2.10, Figure 2.11 and Figure 2.12).

Figure 2.10: Schematic presentation of the desalination – production system of HYDRO 5

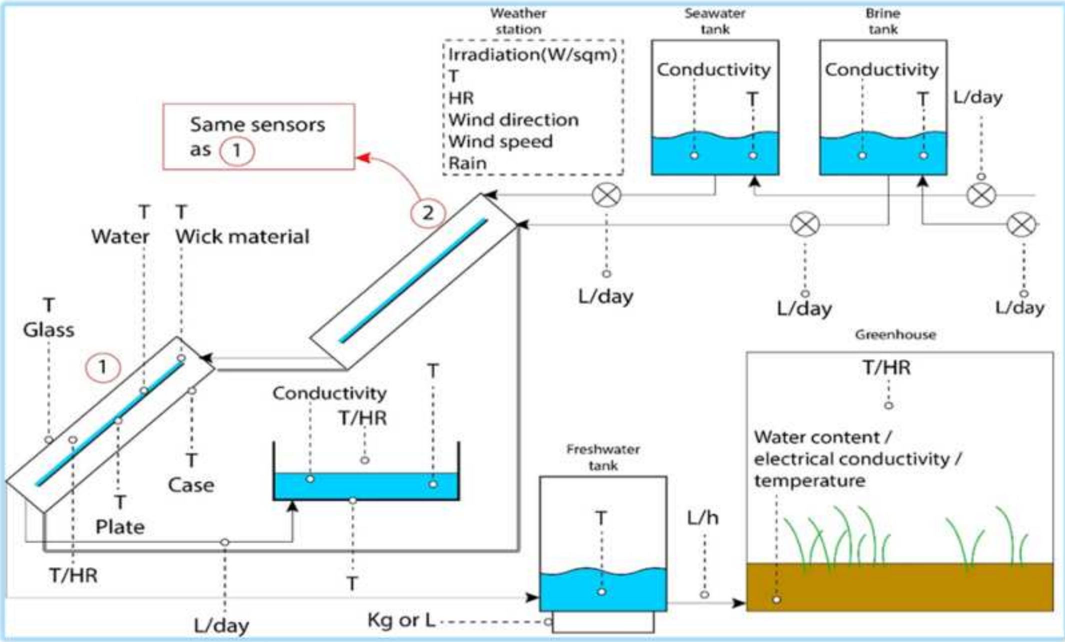

Figure 2.11: Mangrove sensors scheme (HYDRO 5)

Figure 2.12: Mangrove Still desalination system on HYDRO 5

HYDRO 6 Steni, Tinos

At this demonstration area, water loops will be integrated within a remote eco-tourist facility. This includes production of drinking water from vapour water, the treatment of wastewater by CWs, and rainwater harvesting. Reclaimed water, as it was for the previous sites, will be used to irrigate 0.15 ha of local crops and all the activities of the system will be powered using renewable energy. This system will act as a decentralised solution for water and nutrient cycles; there will be no fertilise import, no external water supply will be needed an almost full sufficiency for food production (Figure 2.13, Figure 2.14 and Figure 2.15).

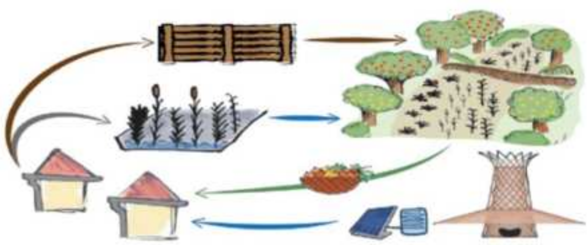

Figure 2.13: Demonstration of HYDRO 6 demo site

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Figure 2.14: The set of the eco-tourist facility with the systems of HYDRO 6

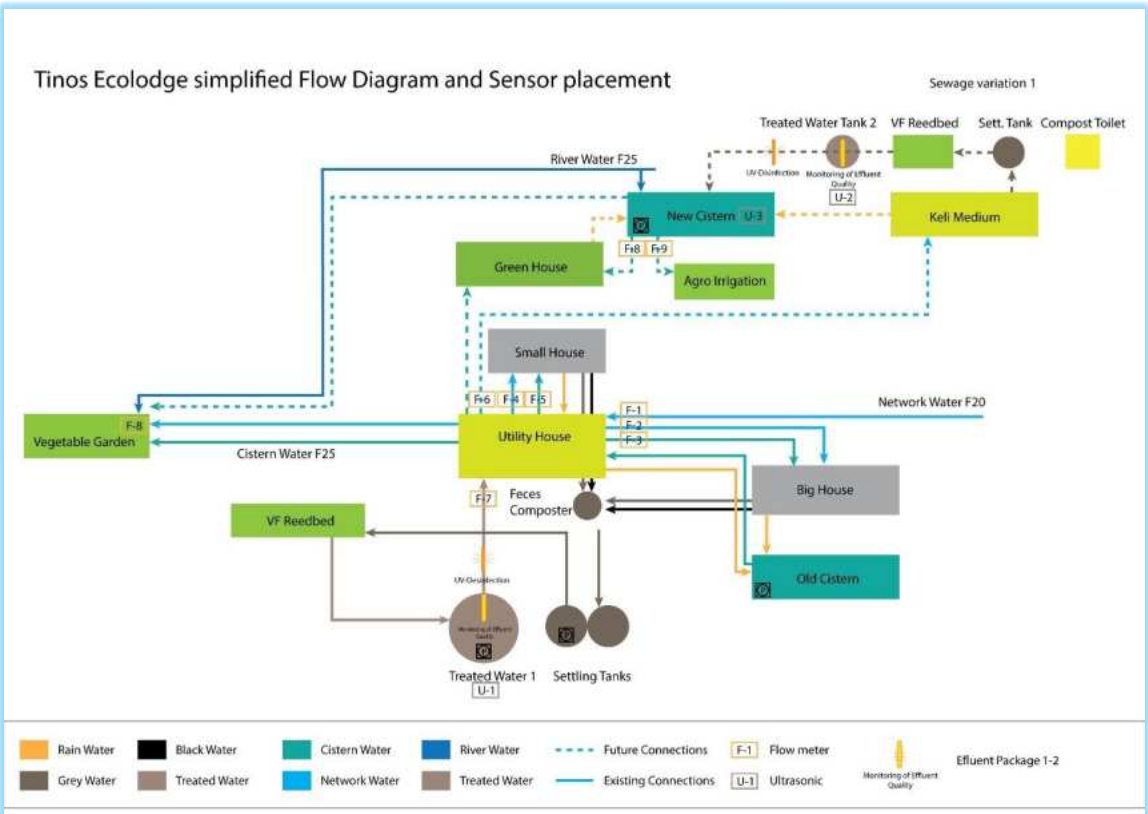

Figure 2.15: Water flows on HYDRO 6 system

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2.3 Initial Demo Site Analysis

At the beginning of the project, an initial demo site analysis was conducted about the requirements and specifications for each one of them. The analysis included a clear description of the HYDRO sites as well as a stakeholder profile. With that, HYDROUSA consortium tried to find out if the selected demo-sites meet the needs of the systems developed at the project. After that, the preliminary specifications were created for each demo site that came out after discussions with local stakeholders in combination with the needs of the individual systems of the project. These specifications were recorded into special sheets (Figure 2.16 & ANNEX I), which were used as questionnaires during the HYDROUSA Technical tour (as explained at the next chapter), for validating these specifications and for identifying any possible deficiencies.

Each sheet/questionnaire was separated into five sections and namely: Sensors – Systems – Irrigation – Software – Other and they were used for recording:

- the needs of the stakeholders
- details regarding the existing infrastructure of the demo sites
- details regarding the current water management and irrigation practices in each site
- details regarding the systems that will be developed in each one of the sites.

In total, five different sheets/questionnaires were created (one for each demo site, HYDRO 1 & 2 was considered the same as it is established in the same area and the water flow of HYDRO 1 moves to HYDRO 2).

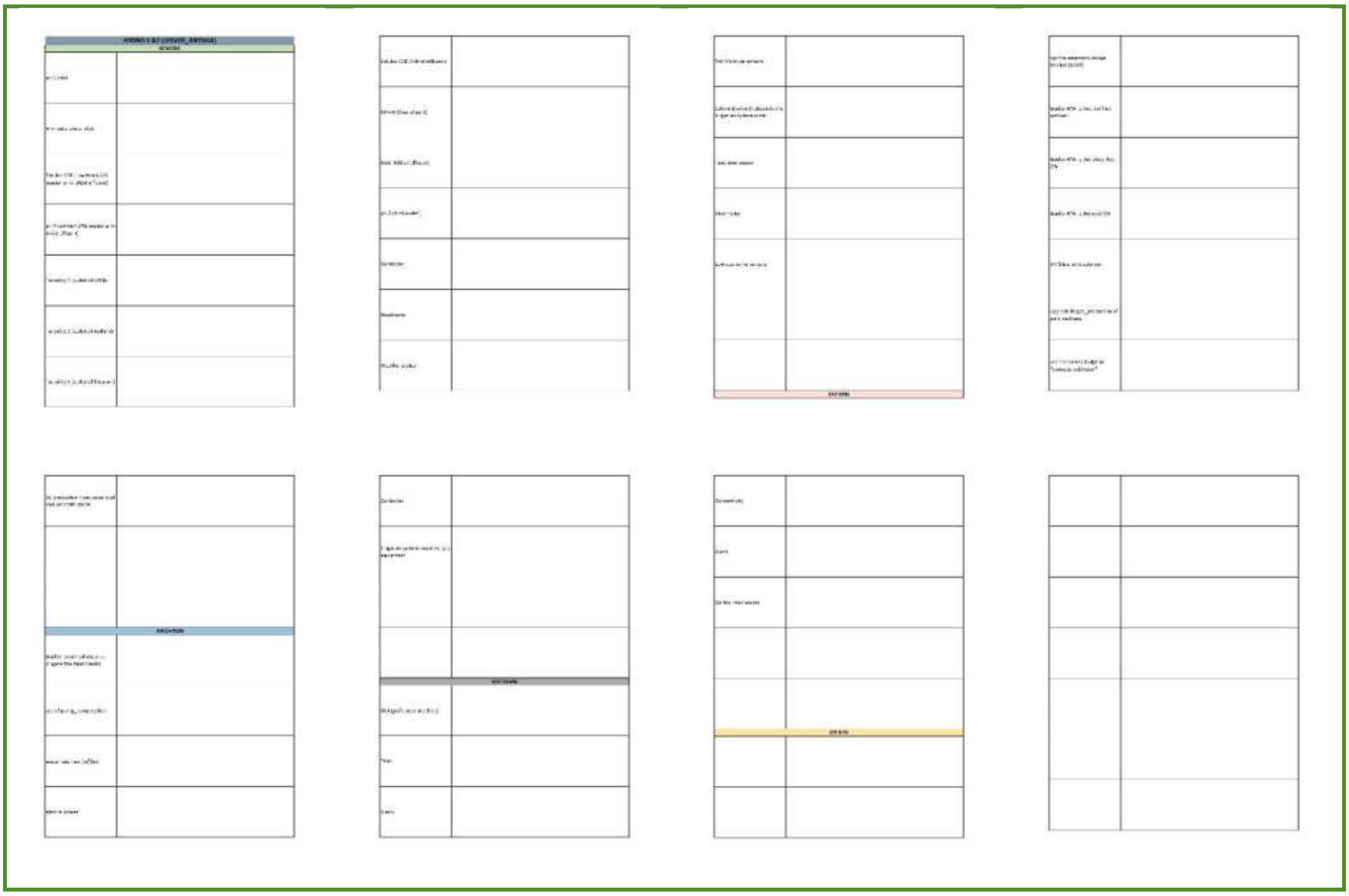

Figure 2.16: Example sheet of the interviews of the stakeholders

2.4 Stakeholder Interviews in HYDRO Sites

An HYDROUSA technical tour to all test sites was organized from the consortium from 17 to 21 of September 2018. During the technical tour, AGENSO staff met with users and stakeholders of the various sites and conducted interviews to identify their needs based on the preliminary specifications (sheets), but also to identify additional information and requirements after investigating the test sites. More than 20 interviews took place with farmers, municipalities, water supply and sanitation companies and others. Stakeholders and users from the demo sites, established in Mykonos, Lesvos and Tinos Island, answered questions related with the water/wastewater treatment and reuse system that will be developed in each demo site. The interviews were structured in such a way, to respond to the different needs of every system, as it was derived through the description of each HYDRO site, while the initial sections classification used in the specification sheets (Sensors – Systems – Irrigation – Software – Other), was followed in order to provide homogenized results.
More specifically, these sections were:

Sensors: In this section the questions were related to the type of sensors needed at the demo sites to measure several physicochemical and water quality parameters as well as to the operations in which they will be used.

Table 2.1: Sample of the questions at Sensors section (HYDRO 1&2)

SENSORS	
pH inlet	
Ammonia probe inlet	
Soluble COD (in UASB effluent)	
Turbidity (outlet of UASB)	

Systems: This part of the questionnaire included the main systems that are developed in each demo site and the crops that will be used.

Table 2.2: Sample of the questions at Systems section (HYDRO 1&2)

SYSTEMS	
Upflow anaerobic sludge blanket (UASB)	
Transfer Wastewater to Vertical flow wetland	
Transfer WW to Bio-electrified CW	
Transfer CW to Vertical flow wetland	

Irrigation: Each system will be used to irrigate different hectares, areas and crops, so the needs for every irrigation system are different. In this section, the required information about the installation of an irrigation system and also the water needs were identified, in order to create the most appropriate water management system for each area.

Table 2.3: Sample of the questions for the development of the Irrigation system (HYDRO 1&2)

IRRIGATION	
Transfer reclaimed water to irrigate 1ha agroforestry	
Use of pump station	
Water rate flow (m^3/h)	
Electric power	

This project has received funding from
the European Union's Horizon 2020
Research and Innovation Programme
under Grant Agreement No 776643

Software: For the better operation of the systems, software has to be developed that will control all the functions of the system. Therefore, another important parameter analysed in this part of the questionnaire was the accessibility and the available network.

Table 2.4: Sample of the questions for the required Software (HYDRO 1&2)

SOFTWARE	
GUI (graphic user interface)	
Alerts	
Connectivity	
Control mechanism	

Other: In this section, the respondents, mentioned other problems or ideas for the optimization of the water/wastewater systems, including general information. They were no specific questions and the interviewers had a conversation with the stakeholders, from which, they proposed solutions and ideas for the better functionality of the systems.

Each section included questions that acquired to the innovation that will be developed at its demo site, so its questionnaire was exclusively designed for its demo site. All these questionnaires that were used during the stakeholder interviews are presented in Annex I.

2.5 Focus Group

A focus group survey was conducted with the stakeholders during the second management meeting at Nice. The aim of the focus groups surveys was to obtain a clearer view on the answers that were received during stakeholder interviews at HYDRO sites, regarding mainly the low-cost system development as well as the platform development. For achieving this, a prototype of the hardware and the software developed from AGENSO was presented to the participants at the beginning of the focus group in order the help in the procedure (Figure 2.17, Figure 2.18 and Figure 2.19).

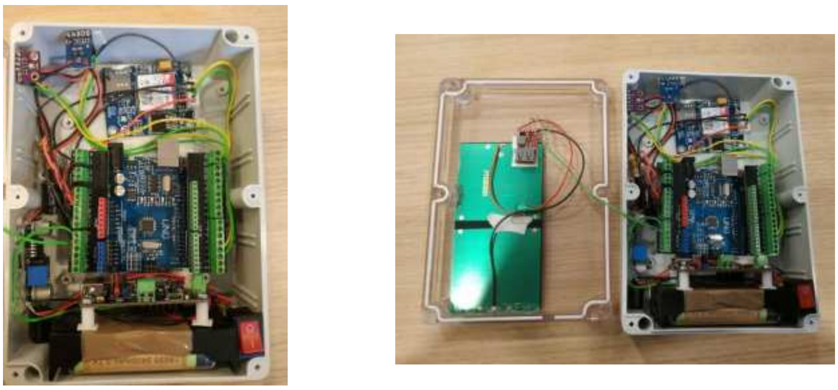

Figure 2.17: Beta version of HYDROUSA Data Logger

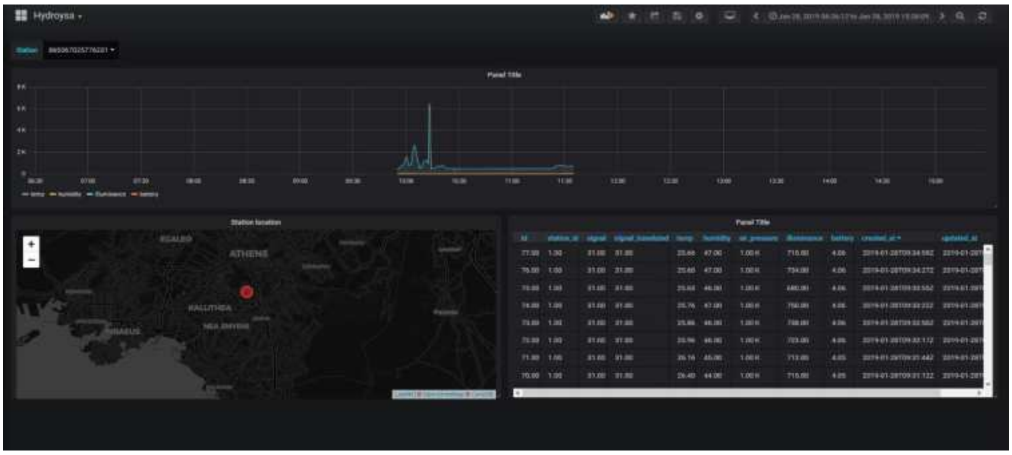

Figure 2.18: Open source platform for monitoring and controlling decentralized water management and agricultural applications

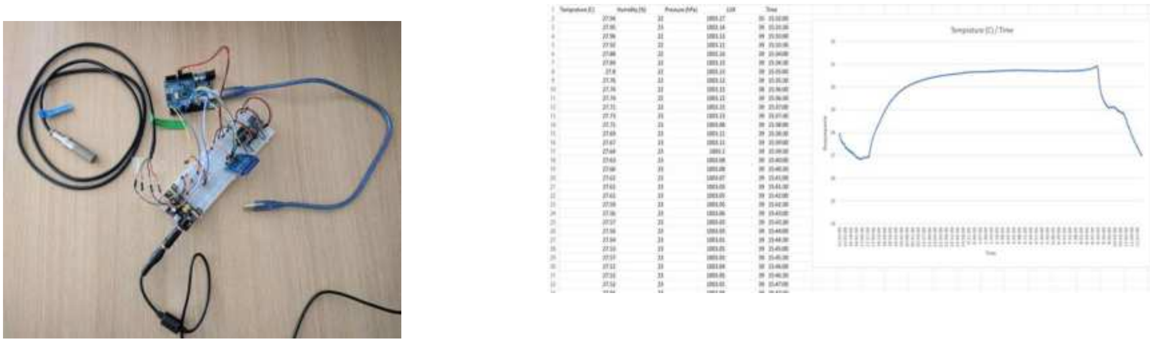

Figure 2.19: Systems performance 'chart

In order to make the various components understandable to all stakeholders, a live demonstration of the systems was made, while the future functionalities of these systems were analysed. Then, a questionnaire was distributed to the stakeholders for each HYDRO site to answer it. This questionnaire consisted of two categories, namely:

i) **General Information about the services**: that included questions about the sensors and the devices needed to be installed and the reasons to use them.

ii) **Software Development:** with questions about the user interface of the software, such as the notifications, the information display, alerts frequency, reasons to use them etc.

The participants firstly referred to basic information about them such as their names and the organization they represent. On the first category of open questions (general information), which was briefly with only 3 questions (Questions 3 to 5), they were asked about the services, devices and the sensors they use at the demo sites and the reason that made them use these devices. The questions that they had to answer are presented on Table 2.5.

Table 2.5: Questions on "General Information" category

"What devices related to HYDROUSA you are using?" "What type of device(s)/sensor(s) do you use with them?" "Which are the reason(s) for using them?"

On the second category, the participants had to answer on questions regarding the alerts, the information, the type of files that they will export, the ability to change algorithms on top of the platform and the reason they wanted to do that, the mandatory alerts and measurements for each participant's needs. In addition, the participants had the chance to add other ideas that will help in the platform development on this section.

The focus group questionnaire as well as the answers of each partner are presented in Annex II and Annex III respectively.

To determine the user requirements, the collected data were analysed using both qualitative and quantitative techniques for ensuring the precision, reliability and integrity of the results. For each HYDRO site questionnaire, the answers from the stakeholders were analysed separately, in order to evaluate even better the situation for each water/wastewater system. The answers from the focus groups were evaluated as a whole, but also for each partner separately. Additionally, the answers from both kinds of surveys (stakeholder interviews and focus group) were analysed based on each HYDRO site needs on sensors, systems, irrigation, software and other needs. The quantitative analysis was conducted using office 2013 Excel (Microsoft, Redmont, USA).

3. RESULTS

3.1 Stakeholder Interviews

As mentioned above, the user requirement procedure was divided in two parts. At first, stakeholders from the demo/pilot sites were interviewed about the systems in the islands, for confirming the preliminary requirements and specifications as well as for providing additional information. More specifically, they answered questions related to the required sensors, the available software, the needs of the systems, the parameters that are involved in irrigation; also, they mentioned other needs that are useful for the functionality of the several water and wastewater treatment systems. Questions included, among others: the kind of alerts they require to receive from the platform, the type of services and sensors they already use, the type of alerts and measurements are mandatory etc. The initial user requirements and specifications regarding hardware ICT infrastructure is presented in the sections below for each one of the HYDRO sites.

3.1.1 HYDRO 1 and 2 – Lesvos Island (Antissa)

At HYDRO 1, a sewage treatment system will be developed in areas with high seasonal loads. The UASB technology will be applied, with which (after the processing) biogas will be produced. The biogas will be upgraded to methane to be valorised as a fuel. Three CW systems will be established in parallel (one full scale and two pilots). Within the UASB reactor/effluent, measurements can be seen through the screen of PLC SIEMENS S7-300 SIMATIC device (Figure 3.1).

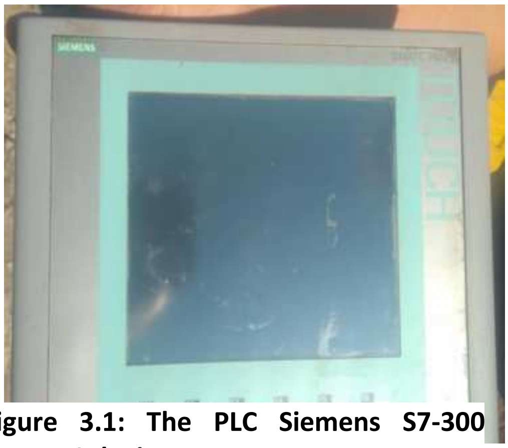

Figure 3.1: The PLC Siemens S7-300 SIMATIC device

At HYDRO 2, the nutrient-rich water will be used to cultivate 1 ha of an agroforestry system that will include forestry trees for fruit and timber productions, bushes and herbs together with annual crops.
Finally, water analysis and turbidity measures at the outlet of the treatment system need to be conducted on a monthly basis. The stakeholders mentioned that in order to better control the system operations, more sensors are required. Those sensors need to monitor climatic data (e.g. air pressure, temperature and humidity), water quality sensors as well as stepper motors.

A summary of the initial requirements and specifications for HYDRO 1 and 2 are presented in Table 3.1.

Table 3.1: Requirements and Specifications for the HYDRO 1 and HYDRO 2 sites

COMPONENTS	REQUIREMENTS	SPECIFICATIONS
SENSORS	Water Quantity measurement	• Tank level sensor • Flow meter • Pressure sensor

		• Turbidity Sensor for outlet of UASB with monthly water analysis • Pressure sensor in pre-filter pipeline and influent pipeline
	Water Quality Measurement	• pH at the inlet and outlet of the UASB reactor controlled with a PLC Siemens S7-300 Simatic • Ammonia at the inlet and treated effluent • Biogas flowmeter • Pressure sensors for the biogas line and upgrade system • Gas detector • Head node • Solenoid valves • Turbidity meter • Conductivity sensor • Soluble COD (final effluent) • NH_4-N final effluent • NO_3-N final effluent • Temperature sensor • pH final outlet • E. coli at the treated effluent directed for irrigation
	Irrigation related sensors	• Weather station • Soil moisture sensor • Humidity
SYSTEMS	Support of different processes	• Oil production from superfood and aromatic plants (hippophaes, oregano, mint) • Upflow anaerobic sludge blanket • Transfer WW to Vertical flow wetland, Bio-electrified CW, to aerated CW • UV filtration treatment • Upgrade biogas production
	Data collection	• Head node
	Control	• Stepper motor • Controller • Solenoid valve
IRRIGATION	Water flow types	• Transfer of water in agroforestry cultivars or fertigation at one part in a masonry type stones from river • Pump station with small pumps • Water rate flow natural with slope that needs to be fixed in the field • There is a river and the field is close to waste treatment (50m)
SOFTWARE	User interaction with electronic devices	• Web interface • Mobile interface

	Communication between electronic devices and software	• GSM connection available
OTHER	Site security	• There are permaculture farmers and there is a need for a fence in order to protect the cultivars from goats also.

3.1.2 HYDRO 3 – Mykonos Island (Ano Mera)

At the third demo site of the HYDROUSA project in Mykonos (HYDRO 3), an innovative rainwater harvesting system will be implemented in a remote area without house roofs. Rainwater will be collected through a sub-surface collection system and stored in appropriate tanks. This water will be used to irrigate 0.4 ha of oregano. This crop was selected because of its low water demands. The system needs to provide the crops with the required amount of nutrients through composting of green material available on site. The interview survey did not mention any specific requirements for the development of the sensors and the different systems. As far as the irrigation system is concerned, there is not power supply as well as a pumping station. Moreover, the field has a slope that favours natural water flow. Regarding the requirements on software and connectivity, the available network connection is a 4G network, while the system needs both mobile and web interface. The derived initial requirements and specifications are presented on Table 3.2.

Table 3.2: Requirements and Specifications for the HYDRO 3 site

COMPONENTS	REQUIREMENTS	SPECIFICATIONS
SENSORS	Water Quantity measurement	• Tank level sensor • Flow meter • Portable multi-probe meter 2FD57G • Conductivity meter • 600320 Turb 430 IR Portable turbidity meter
	Water Quality Measurement f Collected Rainwater	• Turbidity sensor • Conductivity sensor • pH • Temperature sensor
	Irrigation related sensors	• Weather station • Soil moisture sensor
SYSTEMS	Support of different processes	• Construction of sub-surface system • Fertilize composting on site-green material
	Data collection	• Head node
	Control	• Controller • GSM based controller • Solenoid valve
IRRIGATION	Support of irrigation system components	• Sub-surface system • Pumping station • Natural water flow for the irrigation of 0.4 ha • Electric power • Controller

		• Irrigation system
SOFTWARE	User interaction with electronic devices	• Web interface • Mobile interface
	Communication between electronic devices and software	• GSM connection available
OTHER	Site characteristics	• Precipitation level 260 mm/year • At 4 m sweet water, only north winds • Several cultivars like tomato, melons, barley, wheat are cultivated in the area

3.1.3 HYDRO 4 – Mykonos Island (Ano Mera)

At HYDRO 4 site, a rainwater harvesting system of domestic residences already exists and through the HYDROUSA project it will be upgraded. The upgraded system will collect water from an area of 400 m^2 of roofs. This system shall reclaim rainwater and surface runoff to recharge the aquifer, store it in tanks for agricultural and domestic use. A small portion of the water will be treated by a slow sand filter to produce water equivalent to drinking water standards. Through the implementation of HYDRO 4 the problem of aquifer salinization can be reduced. Then, the recovered water will be used to irrigate a 0.2 ha of lavender. Lavender is popular for its essential oil and this is the reason that it was selected for cultivation in HYDRO 4. Regarding the sensors in HYDRO 4, no specific requirements were mentioned.

Figure 3.2: Well at HYDRO 4 demo site

There are three wells in this HYDRO site. Only one of them is functional and will be used in this project. These wells were used to cover daily water needs of the residents. There was agricultural equipment available in the pilot area for several agricultural operations. For the development of the irrigation system, the existing well will be used as a water source, providing approximately 20-30 m^3/day. From the well, two water storage tanks could be filled, the first one has capacity of 40 m^3 and the second 70 m^3.

As the available plot area is bigger than 0.2 ha (could reach 0.8 ha), the expansion of herb cultivation could be achieved at a later time demanding more water, especially during summer. It is important to mention that at the moment no pumping station exists. These two problems can be solved, if we take into consideration that between 13 m to 20 m away from the field, wells can be found. Also, the slope of the field is helpful for the irrigation system, because it favours natural water flow. Another limitation is with the software development, because of the network at the area. There is a 4G fibre network system but there is a poor Wi-Fi connection.

According to the local stakeholders, there is a 22% increase in water consumption the last years (from 2017-2018), especially from May to September due to the high touristic activity. Specifically, the daily needs from May to September of Mykonos Island were reaching 9.000 to 12.000 m^3/day. The wastewater is treated in three gradual processes and a total of 9.000 m^3/day are processed. Because of the high water demands the collection and use of rainwater in domestic residences will contribute to cover the high water demands.

An important factor that will help HYDROUSA's implementation, is that the stakeholders have knowledge on water technologies. To this effort telemetric measurements can also help provide specialists with accurate data, as the respondents mentioned. Local stakeholders mentioned that farmers at Mykonos are familiar with cultivars like olive trees, vegetables, melons, watermelons, aromatic plants etc.

As it was mentioned to the interviewees, the creation of terraces will be suitable for aromatic plants, savoury, figs, some vegetables and black eye peas. Regarding irrigation, clean water can be found and used at the valleys in 4 m depth. It was also very important for the people in the demo site of Ano Mera in Mykonos to create a strong dissemination plan of the project to be potentially implemented at different sites like Delos (another small island near Mykonos), which was an idea of the Municipality. The preliminary requirements and specifications are presented in Table 3.3 as they derived from the initial interviews with the stakeholders.

Table 3.3: Requirements and Specifications for the HYDRO 4 site

COMPONENTS	REQUIREMENTS	SPECIFICATIONS
SENSORS	Water Quantity measurement	• Tank level meter • Flow meter
	Water Quality Measurement	• Turbidity meters (3) • Conductivity meters (5) • pH meters (5)
	Irrigation related sensors	• Soil moisture sensor • Weather station
SYSTEMS	Support of different processes	• Existing harvesting system • System with rainwater collection from the roofs and surface runoff collection • Recharge collected water into the aquifer • Producing potable water through slow sand filtration • Fertilize by composting on-site green material • There is a cistern and they possess agricultural machinery
	Data collection	• Head node

		• Peripheral nodes
	Control	• Controller • Solenoid valve
IRRIGATION	Support of irrigation characteristics	• Transfer water for irrigation of 0.2 ha lavender • Gravity flow of water to minimize energy requirements • With drilling at 110 m and fields without stones
SOFTWARE	Communication between electronic devices and software	• GSM connection available
	User interaction with electronic devices	• Web interface • Mobile interface
OTHER	Site characteristics	• Precipitation level 260 mm/year • One functional well • 22% increase at water consumption form 2017-2018

3.1.4 HYDRO 5 – Tinos Island (Agios Fokas)

At HYDRO 5 seawater and brine from the existing desalination will be treated by the so-called Mangrove Still which will be connected to a tropical greenhouse to produce clean water via evaporation and condensation, edible salt and tropical fruits. So sweet water and salt can be produced from saltwater and at the same time used to grow tropical fruits reducing their imports.

Figure 3.3: The desalination system of Tinos Island

Water needs in the island are high, especially at summer time due to the high touristic activity. For this reason, every summer the Municipality of Tinos Island, rents a complete desalination system to increase the capacity of the existing desalination unit and be able to cover the high demands for water in the island. This is an industrial fully equipped system installed in a container (Figure 3.3). In the desalination system several parameters are measured and specifically pH, temperature, pressure etc. (Figure 3.4). Those measurements are required for HYDROUSA's system as well. The control mechanism and process are under study and will be determined as the resources and their capabilities are determined.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 776643

Figure 3.4: Measurements of the desalination system in Tinos (pH, temperature, pressure, conductivity)

The existing water supply system in Tinos was composed with three different water resources: a desalination system that can cover the needs of 6000 people. There is a 200 m pipe that discharges the brine into the sea and a pipe to collect the inlet seawater. The overall cost of water was 1€ per cubic meter. The desirable water chain that is created is between hotels and restaurants, farmers and crops.

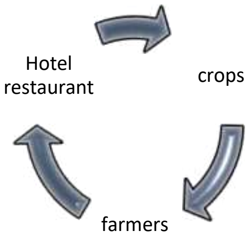

Figure 3.5: The water chain that stakeholders require

The initial requirements and specifications for the development of the ICT hardware infrastructure of HYDRO 5 is presented in Table 3.4.

Table 3.4: Requirements and Specifications for the HYDRO 5 site

COMPONENTS	REQUIREMENTS	SPECIFICATIONS
SENSORS	Water Quantity measurement	• Tank level • Flow meter
	Water Quality Measurement	• Conductivity • pH for seawater and final water • Turbidity for the final water
	Irrigation related sensors	• Temperature and humidity sensors • Soil moisture
SYSTEMS	Support of different processes	• Connection with the existing desalination plant • Construction of the greenhouse • Cultivation of tropical fruits • Clean water production • Edible salt production • Municipality systems with closed water loops
	Data collection	• Head node
	Control	• Solenoid valve • Controller

IRRIGATION	Support of irrigation characteristics	• Irrigation inside the greenhouse • Pumping station • Water flow rate • Electric power • Controller • Irrigation system equipment
SOFTWARE	User interaction with electronic devices	• Web interface • Mobile interface
	Communication between electronic devices and software	• GSM connection available
OTHER	Site characteristics	• Maintain photovoltaic system, venture at greenhouse • 300m^2/day seawater and 200m pipe for brine to sea • Fast crop cultivation

3.1.5 HYDRO 6 – Tinos Island (Steni)

At this pilot area, water loops will be integrated within a remote eco-tourist facility. This includes production of potable water from vapour water, the collection and use of rainwater and the treatment and reuse of sewage. Rainwater and reclaimed water will be used to irrigate 0.15 ha of local crops and all the activities of the system will be powered using renewable energy sources. At HYDRO 6 already exists an eco-tourism facility under the name of TINOS ECOLODGE that has implemented most of the aforementioned systems like the rain water collection and storage; power supply; composting human manure; waste water treatment and use of treated water for non-edible plants and trees. TINOS ECOLODGE is an eco-friendly tourist destination that uses the natural resources of the island in sustainable way for the needs of a household. It will be a decentralised solution for water and nutrient cycles, with no imports of fertiliser and no external supply available.

Regarding sensor requirements, there are no specific needs according to the participants. There is only the need to find the closest weather station located in Steni area. The wastewater is treated by reed beds and disinfected before use. Water is collected in a cistern construction; its depth is 3 m and they can use it for irrigation. At the demo site a water storage tank existed with 100 m^3 capacity and the whole system was energy autonomous using solar panels and batteries where the energy is stored. It provided 2 days of autonomy and produced drift equal to 48.8 V, so it can be used to power all the systems of ECOLODGE. The pump that leads to the reed beds provided flow of 5 m^3/h. For the irrigation of the vegetables, river water running with the natural flow, can be used. On the west side of the field, the irrigation was held with a drip irrigation system. However, the connectivity of the network in the area was limited, so in order to have the 4G network and operate the software, all the installation had to be on the East side of this pilot area. Some common cultivars that were cultivated in the area included artichokes and caper. The requirements and the specifications of this demo site are presented in Table 3.5.

Table 3.5: Requirements and Specifications for Demo site HYDRO 6

COMPONENTS	REQUIREMENTS	SPECIFICATIONS
SENSORS	Water Quantity measurement	• Tank level • Flow meter
	Water Quality Measurement	• Turbidity meter (final outlet water and treated wastewater) • pH (water, wastewater) • Conductivity (final outlet water, treated wastewater) • Multi 3630 IDS SET G • 600320 Turb 430 IR Portable turbidity meter
	Irrigation related sensors	• Weather station • Soil moisture sensor
SYSTEMS	Support of different processes	• Establishment of the system for drinking water production • Treatment of domestic wastewater, subsurface water collected with perforated pipes
	Data collection	• Head node
	Control	• Controller • Solenoid valve
IRRIGATION	Support of irrigation characteristics	• Irrigation of local crops • Pumping station • Water rate flow • Electric power • Controller • Irrigation system equipment with natural water flow and river water to irrigate vegetables
SOFTWARE	Communication between electronic devices and software	• GSM connection available only in east part of the pilot area
	User interaction with electronic devices	• Web interface • Mobile interface
OTHER	Site Characteristics	• Construction of a cistern 100 m^3 irrigation because they have a lot of water at 3m depth • Installation of 2 solar driven condensation unit • Photovoltaic battery system

3.2 Focus Group

As mentioned above, focus group survey, with the help of questionnaires, was conducted with main focus on deriving the initial requirements and specifications of the software components of the ICT infrastructure. The answers on each questionnaire that was filled during the focus group survey, were analysed separately, because of the differentiation in the type of questions. For the first section of the questionnaire, the analysis was based defining the needs of each HYDRO site, while in the second section, the answers were processed separately for each partner, as well as for all the partners in general. At the end, all the answers were combined in order to achieve homogenized qualitative analysis.

3.2.1 Results on General Information

At this part of the questionnaire, the participants provided answers to questions about the services, devices and sensors related to HYDROUSA project they were using (questions 3 to 5), as well as the reason that they want to use them. The answers to these questions for each partner are presented in Table 3.6.

Table 3.6: Focus Group answers in General Information category from each partner

PARTNER ORGANIZATION	ANSWER
ICRA – Catalan Institute for Water Research	They are collecting weather data and parameters, and they are measuring water quality. They are not using any device or sensor directly but they are making use of the information that these sensors measure.
NTUA – National Technical University of Athens	The main focus for NTUA is on demo site HYDRO 1 and specifically on the monitoring system and the system for the wastewater treatment for agroforestry usage. They stated that they are using sensors to measure the physicochemical parameters of the water. These measurements help them to monitor the efficiency of the processes and control the systems' overall operations, with main aim to optimize its performance.
MINAVRA S.A. Constructions	MINAVRA is responsible for the development of the irrigation and wastewater system, as well as the automations, the PLC and the SCADA pumps. They are using this equipment for common functions.
UNIVPM – Universita Politecnica Delle Marche	The energy consumption of water/wastewater treatment was used by UNIVPM for measurements. They are using water quality data, flow rate data, weather measurements and biogas quality parameter calculations. They are using conventional sensors and devices, with which they were measuring common parameters. The results and the accuracy of these sensors were satisfying for them, so the UNIVPM partners mentioned that there is no need for high cost sensors.
IRIDRA SRL	They are using sensors, devices and services, in order to understand, if there is a fail at the treatment design. The services they are using, include monitoring tools and online probes that measure COD, ammonia and nitrates electrochemical probes and devices that measure pH, temperature, DO.
Brunel University of London	Brunel University partner, are using data from the PLC and tools such as MFA, LCA and LCC for mapping current and HYDROUSA system to validate their systems. The services they are using, are environmental data, economic assessment, social impact analysis, water-food-energy nexus and the circularity assessment.

Satistica	They are using data services and also they are having access to the sites in order to collect information. For obtaining data and create performance measures, they are collecting information by using PLC systems, software applications and SCADA systems for environmental monitoring. They are also using data for traceability reasons
ELT – Tinos Ecolodge	Ecolodge in Tinos stated that they wanted to use HYDROUSA's services as an open source and as a very good interface extendable in a way that can involve the community to the development of the project and also for the greenhouse and especially to control windows, humidity and temperature. The services wanted to use were the greenhouse and irrigation control, the mechanical flow meters, the weather station and the photovoltaic monitoring.
IHA – Impact Hub Athens	Impact Hub is related with HYDROUSA services because they want to collect information for the external and internal communication and to identify trends. They are using mobile phone applications, push notifications and computers, for social media (Facebook, Twitter, You Tube, LinkedIn), as well as the social impact analysis.
AERIS – Technologias Ambientales	AERIS partners are involved with the services related to the anaerobic treatment systems, monitoring and control. Sensors/devices and territory treatment. They are collecting measurements from the sensors related to flow rate (biogas and water flow rate), biogas productivity, pressure level, temperature, pH and redox. In this way, they strengthen the reliability/stability of the system and control its turbidity.
ALCN – Alchemia Nova Institute for Innovative phytochemistry and close loop processes	ALCN wanted to use the devices/sensors, to measure the physicochemical parameters of the water (temperature, conductivity, COD, BOD, turbidity, TSS, pH) and environmental parameters like humidity for the evaluation of water quality, decision triggers and the systems performance. Some of HYDROUSA's services that they wanted to control was composting, water condensation, water evaporation and to be able to change and control the threshold of several parameters.
PLENUM	They are using Google drive, zoom online calls and Skype services.
Municipality of Tinos	In order to monitor the Davis weather station that they own for recording the weather parameters, they are using the Weather Link software.

A summary table of all the answers that were given by the HYDROUSA partners for each question is presented in Table 3.7.

Table 3.7: Answers to the General Questions

QUESTIONS	ANSWERS
Usage of services related to HYDROUSA	Most of the respondents (around 50%) are using services to evaluate wastewater conditions after treatment such as water quality data and flow meters. 30% are using monitoring tools, sensors and solar panels. The remaining 20% are collecting weather and climatic data from weather stations and are also measuring environmental parameters. A few of them were using social media, Skype, zoom online calls and google drive.
Device(s)/Sensor(s) that are used with the services	The majority of the participants (around 60%) stated that they use probes to measure physicochemical parameters (e.g. DO, pH, redox, NH4, COD, BOD, conductivity etc.), wastewater treatment efficiency, pressure, temperature, biogas. Also, a 40 % of them are using SCADA systems.
Reasons to use them	The use of these services was mainly for common measurements of parameters such as water quality and system condition and monitor the efficiency of the system and of the process, in order to optimize system's performance.

Based on the aforementioned, there were different needs that need to be tackled by the ICT infrastructure.

3.2.2 Results on Software Development

This section included questions regarding the software development, the alerts and information that users want to receive, the type of files they want to export, the ability to change algorithms on top of the platform and the reason they want to do that, the mandatory alerts and measurements for each partner needs. Here, the participants had the chance to add other ideas that will help to the platform development (Questions 6 to 16). The results for each question are provided below.

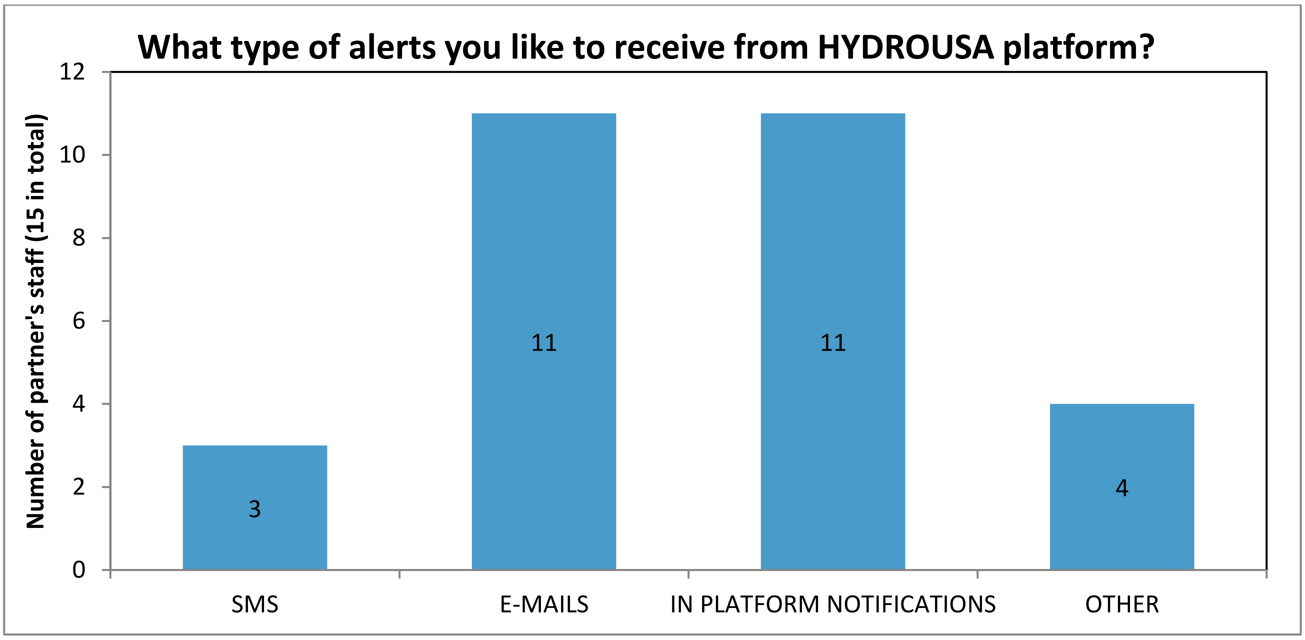

Chart 3.1: Total results for the preferable type of alerts

Most of the partners stated that they want to receive notifications from the platform from e-mail or with in platform notifications (73% for each case), while 27% prefers other type of notifications (e.g. Facebook posts) and only 20% prefers via SMS. All partners except form Satistica and ELT chose e-mails, while in-platform notifications were preferable for almost all of them except from ICRA, MINAVRA and AERIS. NTUA and IHA selected the SMS option. PLENUM suggested that Facebook posting can work as a type of alert, while partners from IHA and ELT mentioned that alerts should be displayed on devices (Chart 1).

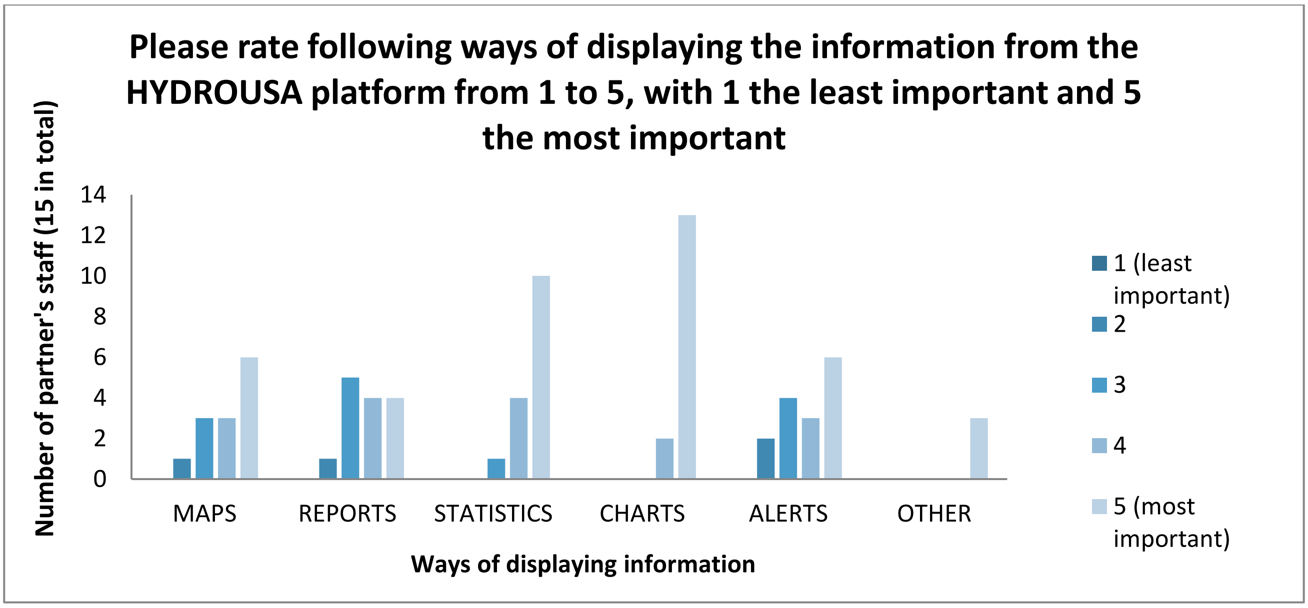

Chart 3.2: Display of the measurements and the information

Most of the participants, rated as the most preferred way to display information through charts and statistics. After that, alerts and maps were considered as a good way to present the required information to the partners. The less important method was the reports. It was really interesting that none of these ways was rated as least important. For ICRA, most important are statistics and charts, followed by reports. For NTUA, the most preferable way was with charts and alerts and statistics and reports received a rate of 3 (important). MINAVRA partners rated maps, statistics and charts as the most important way, and less important for them were the reports. UNIVPM believes that maps and charts were very important as well as alerts and statistics. IRIDEA SRL, rated with 5 (most important) statistics and found less important the alerts (rated with 2). For Brunel University and Satistica, all the suggested ways were important, while Satistica suggested raw data to be another way of displaying data. Statistics and charts received a 5 rate (most important) from the ELT and IHA partners, and ELT rated reports as most important (5 rate). AERIS and ALCN found charts and alerts important and ALCN added the option of controlling the alerts. PLENUM partners supported the usage of maps, statistics and charts and representatives of Municipality of Tinos stated that maps and charts will help them understand the platform data (Chart 3.2).

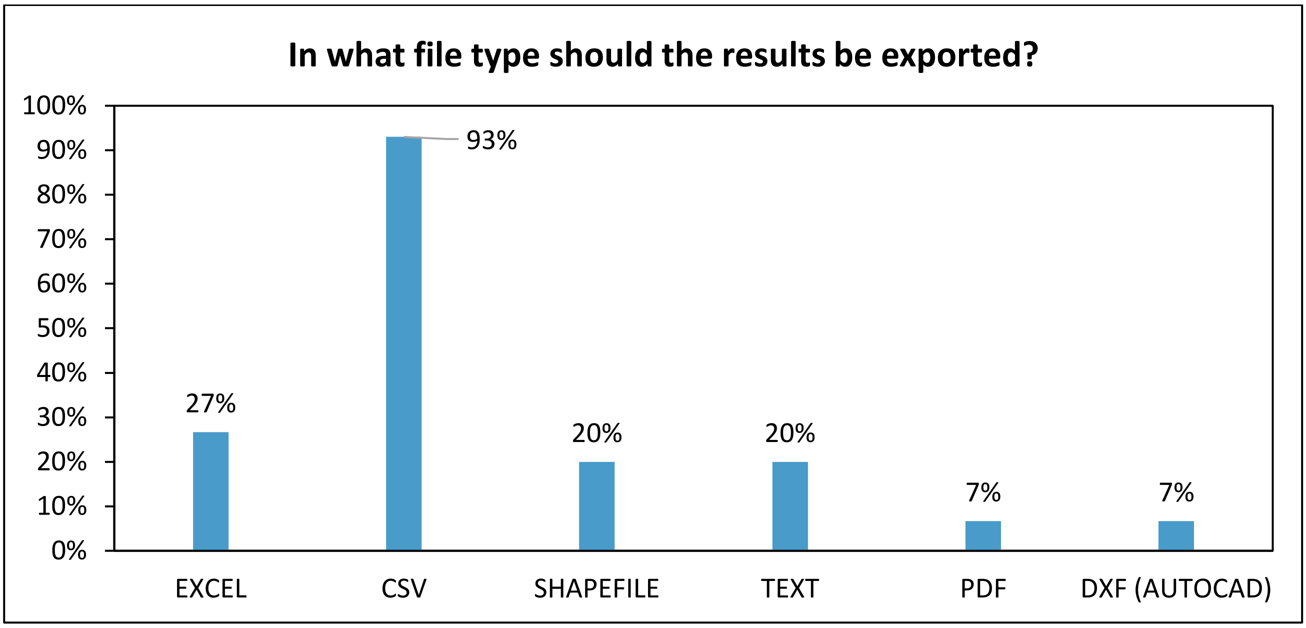

Chart 3.3: Type of files

All partners, except from the Municipality of Tinos preferred to export files in form of CSV, which was the most preferred file type with 93%. Microsoft Excel files followed with 27%, selected from NTUA (one of the two participants chose them), MINAVRA and IHA. Text files came third (received 20%) and were selected by Brunel University, Satistica and Plenum. While, shapefiles (also third with 20%) was a way that Municipality of Tinos, Brunel University and IRIDEA wanted to have as an option for exporting their files. Finally, both PDF and DXF file formats received 7% (Chart 3.3).

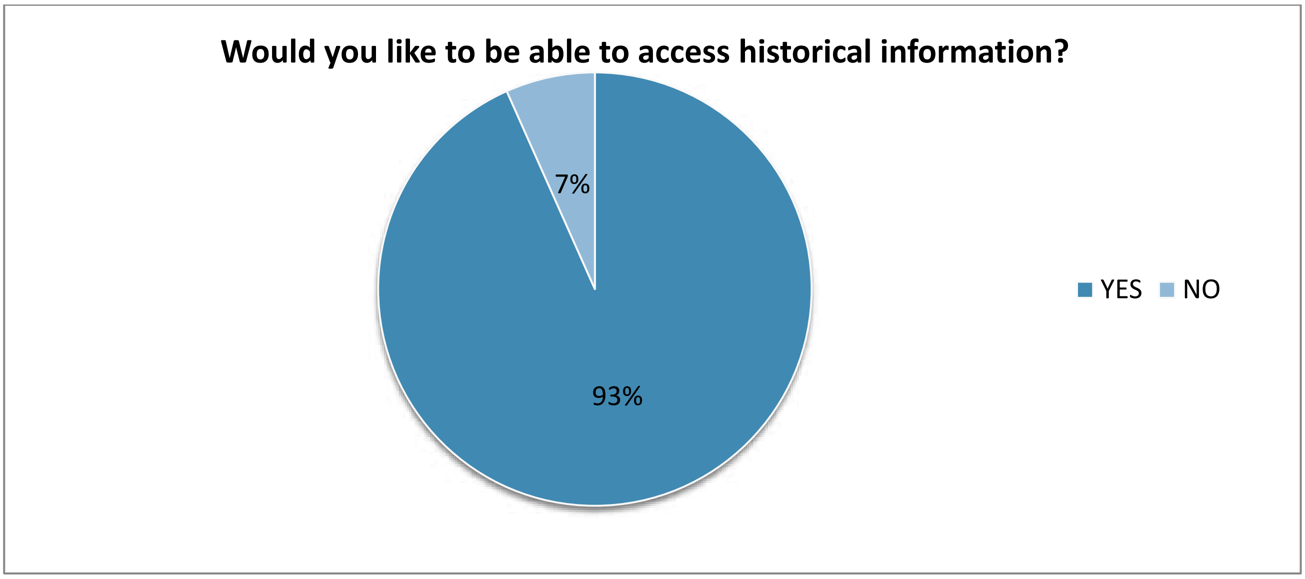

Chart 3.4: Access to historical information

The access on information from previous measurements and observations was perceived as very important, because it helps at the better development of the new systems. This was also important for almost all the HYDROUSA partners, as it can be clearly seen on Chart 4. A percentage of 93% of the participants believes on the importance of historical information. Only, partners from PLENUM (7%), stated that they do not want to have access to historical data.

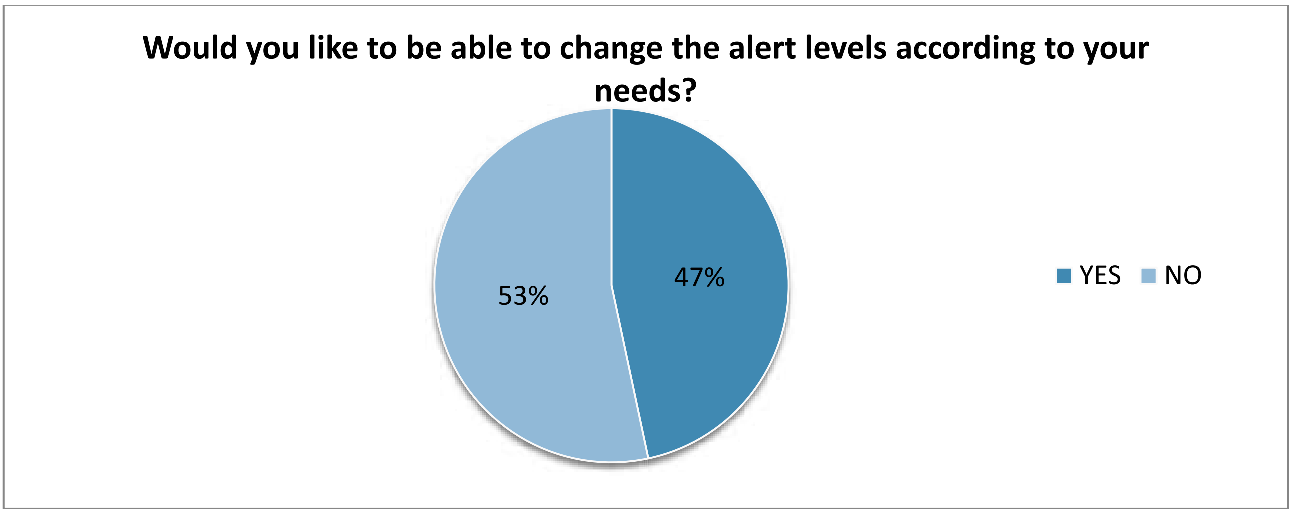

Chart 3.5: Change the alert levels

The majority of the partners do not want to change the alerts level with a percentage of 53% versus 47%. NTUA, IRIDEA, ELT, AERIS, ALCN, PLENUM and Municipality of Tinos stated that they would like to change the alerts. They presented different reasons that made them want to change the alert levels. More specifically, they mentioned that not all of the received information addresses their requirements and they want alerts for cases such as equipment malfunction, so they can be ready to actuate. NTUA stated that, in this way the operation of the systems will be improved. Partners from IRIDEA mentioned that if they get too many alerts they want to have the chance to decide to rise up the alerts level depending on the significance of the alerts. For a potentially breakdown of equipment, Satistica and AERIS would like to change the alert levels (Chart 3.5).

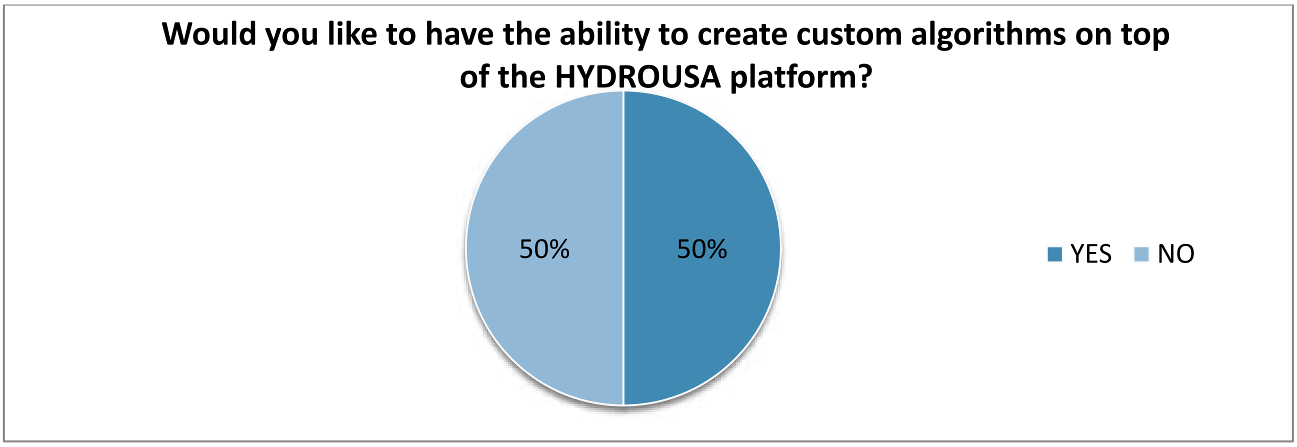

Chart 3.6: Ability to create custom algorithms

Brunel University and Satistica supported the creation of custom algorithms as they will use them to create new knowledge. ALCN and UNIVPM acknowledged the importance of these algorithms, for evaluating replicability and triggering actuators. Creating algorithms could help them to correlate parameters with performance indices or make correlations between the parameters, was what NTUA said about this question, while ELT reported that they will adapt the charging needs in crop cultivation levels by using custom algorithms. Between those that didn't want this ability were ICRA, MINAVRA, IRIDEA SRL, IHA, AERIS and Municipality of Tinos. Finally, PLENUM did not answer this question.

The last three questions of the focus groups questionnaire, were related to the mandatory alerts and measurements, for each partners' needs. Also, all the partners had the opportunity to write other comments that will optimize the operations of the HYDROUSA systems and will help them to extract accurate results. These questions, as well as the answers are presented on Table 3.8.

Table 3.8: Mandatory alerts and measurements for every partner, general comments

PARTNER	Which type of measurements are mandatory for your needs?	Which type of alerts are mandatory for your needs?	Other comments
ICRA	Water and wastewater quality parameters, flows	Alerts about the operations, malfunctions, for water quality parameters, flow, water level	-
NTUA	Flow, water level, water/wastewater quality physicochemical parameters	Alerts for the flow, quality parameters, water levels, efficiency	-
MINAVRA	-	-	-
UNIVPM	Energy consumption, water influent, water quality data, flowrate data, weather conditions	Sensors, probes, service	-

IRIDEA	-	Pollutants concentrations	Notifications when concentrations are over the regulation limits
Brunel University	Energy, water quality, quantity of nutrients in the water, flows	-	-
Satistica	Data from the plants and farms, information of product traceability	Equipment state and breakdown	-
ELT	Water level, climate parameters, soil parameters, water quality	Rate the risk level, extreme rate of temperature, pH and EC measures	Documentation of hardware, setup, software, commented code
IHA	-	-	-
AERIS	Pressure levels, flow rate, biogas parameters, turbidity	HH ad LL alerts for all the measurements	-
ALCN	Temperature, conductivity, humidity, turbidity	Alerts for parameters measurement that are above threshold	-
PLENUM	Carbon and water footprint	-	-
Municipality of Tinos	-	Temperature and rain alerts	-
SUMMARY FROM ALL THE PARTNERS	Around 70% of the participants, mentioned that is really important to have water and waste water quality parameters (pH, DO, nutrients, salinity, conductivity, material flows, turbidity), 20% need climatic parameters (temperature, humidity, wind speed, wind direction, rain, UV) and 10% asked for carbon footprint data.	Alerts in case of a breakdown of the equipment are important for half of the questionnaires. Another 50% wants alerts for pollutant concentrations and quality parameters (pH, EC, temperature, humidity), to operate different tasks.	Some participants mentioned that it would help, if there was hardware and software setup and a community platform for future development by a community.

Based on the aforementioned results, it needs to be highlighted that there are different requirements and consequently different specifications regarding both software and hardware ICT infrastructure among the partners of the HYDROUSA project. This needs to be addressed properly during the development and integration of the ICT systems in the HYDRO sites providing to them all the appropriate capabilities. Thus, the co-creation process will be followed for the development and integration of the ICT systems while these systems will be evaluated through the participation of other stakeholder groups also like citizens, farmers and consumers. The updated results on the requirements and specifications that will derive through the next project activities will be reported in D5.3 - Updated user requirements and specifications definition.

4. CONCLUSIONS

This deliverable, has elicited the initial user requirements and specifications for HYDROUSA demo sites and software development. Effective monitoring and control of the HYDROUSA demo system will take place through ICT integration. Sensors, controllers and actuators will be deployed for monitoring and controlling important parameters, while data communication will be achieved between the components. Data will be stored in a data repository, and a platform for monitoring and controlling HYDROUSA systems will be developed.

The identification of user requirements is required in order to achieve the main aim of the project, which is to solve the water supply issue and the wastewater problem, the biodiversity and nutrient loss, the availability of jobs (mainly in the high touristic season), and the flush of difficulties that infrastructure has to deal with at the peak of the touristic season, resulting in the unsustainable water demand. To define them the human centred design methodology was followed (Maguire and Bevan, 2002) using a synthetic category which included conversational and observational methods (Umber, et. al, 2012). The aforementioned approach, helped on defining the initial user requirements and specifications from the stakeholders' perspective and specifically from those that will be responsible for the proper operation of these systems.

Except from the requirements of the end users, each demo site has different needs. In order to fulfil the needs of the different treatment systems, the results from the questionnaires were analysed separately. In conclusion, for HYDRO 1 and 2, a sewage treatment system will be developed and the UASB technology will operate even at relatively low temperatures, taking advantage of the much lower flows of sewage in winter, which allow increasing the hydraulic retention time (HRT). The excess sludge from the UASB will be mixed with biomass and co-composted in an innovative in-vessel composting system, with humidity capture and plants that treat the odours. The UASB effluent will either be treated in constructed wetlands (CWs), filtered and disinfected for reuse in agriculture, or will directly be used for fertigation after disinfection. The nutrient-rich water will be used to cultivate 1 ha of an agroforestry system. The agroforestry system will be divided in 3 main groups; 1) Forestry trees for fruit and timber production, 2) Orchards/bushes and 3) Herbs and annual crops. Superfoods like goji berries and aromatic plants will be planted and utilized for essential oils production. The plant setup will be co-creatively elaborated with the public for a definition of business cases and to form resilient ecosystems. For better operation of the system, it was required to have monthly analysis of water quality and to control the UASB reactor with sensors. Also monitoring all the measurements using monitors like PLC Siemens S7-300 Simatic, will be very helpful for calculations on the spot. The super foods and aromatic plants that will be cultivated and will be able to produce oil include, hippophaes and goji berries. Another important factor was that the field has stones, so its masonry type and the slope is appropriate for natural water flow, with no need for big pumps and high energy consumption. The water that will irrigate the plants can be found from the river close to the test field. For the software operation a 4G network was available. For the partners, it is really important to assure the quality of water and the cultivars. For this reason, they would like to use sensors for monitoring physicochemical parameters, climatic and weather data, they would like to receive alerts about malfunctions, measurements out of the threshold and high levels of bacteria like E. coli.

In the pilot area of HYDRO 3, an innovative rainwater harvesting system will be implemented in a remote area in Mykonos, with no availability for water collection on house roofs. This will be possible through rainwater harvesting, with precipitation per year being up to 100 mm. The system will consist of a sub-surface rainwater collection system that will harvest water for irrigation of 0.4 ha of oregano. For the irrigation system, natural water flow will be used and sweet water can be found on 4m. For the connectivity a 4G network will be used. For this demo site was important to know the water flow and evaluate the water quality parameters before irrigation. Weather conditions are very important in this test case, because the whole system is based on rainwater harvest. The weather station and alerts about weather conditions are really important.

HYDRO 4 demo site, will upgrade an existing rainwater harvesting system of domestic residences to reclaim potable water after slow sand filtration and recharge water into the aquifer, mitigating the long-encountered problem of saline water intrusion. The water will be used to cultivate 0.2 ha lavender from which essential oils will be extracted and the whole cultivar will be provided with nutrients through composting of greens available on-site. The irrigation area is between 0.4 to 0.8 ha and irrigated and non-irrigated crops can be cultivated and the water flow reaches 20 m^3/day. This will be controlled through the sensors for water flow and in cases of improper use or measurements over threshold the stakeholders will be informed through alerts. A problem faced in this pilot area is the connectivity. Before irrigation, the water will be gradually processed for three times. In this demo site, important notifications are those related to filtration, water quality, water flow and level.

Demo site HYDRO 5 in Tinos, will have greenhouse based on Mangrove still for having clean water, which will be produced via evaporation and condensation. The system will be connected to the new wastewater facilities. Required sensors for this area are water quality sensors, sensors measuring water physicochemical parameters etc. It needs to be highlighted that Municipality of Tinos rents a desalination unit during summer for addressing the high needs on clean water due to the high number of tourists visiting the island. Thus, the ICT system needs to take also into account the sensors and data coming from this unit.

In HYDRO 6, water loops will be integrated within a remote eco-tourist facility. These loops include the production of drinking water from vapour water using a fog catcher system, the wastewater treatment using reed beds and rainwater harvesting. Reclaimed water will be used to irrigate 0.15 ha of local crops. This system of water treatment will make the local ecotourist facilities to be self-sufficient. The software will operate with a 4G network system sending alerts for the weather conditions and the water flow. Another important factor for this test area is the lack of weather station close to the demo site, because climatic data are required for better operation.

About the ICT components development, all partners mentioned the importance of evaluation of wastewater and water conditions by measuring physicochemical parameters like pH, temperature, turbidity, COD, BOD, DO etc. In this way, they can control and optimize the several systems that will be developed in the HYDRO sites and upcoming malfunctions can be avoided. In addition, they pointed out, that they want to be up-to-date for the systems operations. They would like to receive information from HYDROUSA platform through in-platform notifications or e-mails and the majority of them wanted the information to be displayed in form of charts and statistics. They stated that they were not negative on receiving other type of information like maps, reports and alerts. The results of each operation should be exported in CSV or Microsoft Excel formats and all partners wanted to have the opportunity to access historical data. Changing alert levels was for most of the partner’s undesirable, but there was a big percentage of those that wanted to change them, so this aspect needs to be addressed accordingly. The ability to create custom algorithms was a point that split the partners into half. Some of them believed that this will not help at the improvement of the platform, while others thought that processes like parameters correlations, evaluation of replicability, creation of KPIs knowledge and triggering of actuators could be facilitated if its partners create custom algorithms.

Concluding, this deliverable will help in the development of both hardware and software ICT solutions that will be developed and integrated in each HYDRO site. Moreover, these initial user requirements and specifications will be tested and evaluated by each stakeholder after the employment of each developed solution. In addition, new stakeholder groups will participate in the process (e.g. farmers, citizens, consumers) for eliciting better the user requirements and consequently the technical specifications from the end users perspective. Finally, the received feedback from the stakeholders will help on fine-tuning the initial user requirements and specifications, while the updated user requirements and specifications will be reported in D5.3 - Updated user requirements and specifications definition.

The next step for the development of the ICT platforms is to generate the documents for the Hydro physical systems layout, the list of equipment positioned, the piping and instrumentation diagram to ascertain the power and general system demand and building the monitoring and control units for designated sites. Pending the need, complexity, terrain and the availability of most suitable equipment, some sites will be equipped with classical industrial control units such as PLCs and HMI systems (i.e. Hydro 1&2) and some will use low cost monitoring systems (i.e. Hydro 6), or at times a combination or; a final rationalisation (i.e. Hydro 3,4 and 5). This will be achieved as the system equipment are purchased and installations take place.

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6. ANNEXES

6.1 Annex I – Demo Sites – Stakeholder Interviews

Table 6.1: HYDRO 1 AND 2

SENSORS	
pH 1 inlet	
Ammonia probe inlet	
Soluble COD 1 (in UASB effluent)	
pH (in UASB effluent)	
Turbidity 1 (outlet of UASB)	
Turbidity 2 (outlet of wetland)	
Turbidity 3 (outlet of filtration)	
Soluble COD 2 (final effluent)	
NH4-N (final effluent)	
NO3-N (final effluent)	
pH 2 (final outlet)	
Controller	
Head node	
Weather station	
Soil Moisture sensors	
Solenoid valve (It depends the irrigation system used)	
Tank level sensor	
Flow meter	
Other low-cost sensor	
Pressure sensor Temperature Redox	
Humidity weight	
E. coli	
Photometric sensor	
Stepper sensor	
SYSTEMS	
Upflow anaerobic sludge blanket (UASB)	
Transfer WW to Vertical flow wetland	
Transfer WW to Bio-electrified CW	
Transfer WW to Aerated CW	
UV filtration treatment	
Upgrade biogas_production of pure methane	
Use the excess sludge to “Compost cultivator”	
Oil production from superfood and aromatic plants	
IRRIGATION	

Transfer reclaimed water to irrigate 1ha Agroforestry	
Use of pump_pump station	
Water rate flow (m^3/h)	
Electric power	
Controller	
Irrigation system- masonry type equipment	
SOFTWARE	
GUI (graphic user interface)	
Time	
Alerts	
Connectivity	
Users	
Control mechanism	
OTHERS	

Table 6.2: HYDRO 3

SENSORS	
Turbidity 1 (untreated before filtering – if possible)	
Turbidity 2 (treated water Probe immersed within Tank)	
Conductivity-Treated Water immersed in Tank	
pH 1 inlet	
Controller	
GSM for controller (only low-cost scenario)	
Head node	
Weather station	
Soil moisture sensors	
Solenoid valve (It depends the irrigation system used)	
Tank level sensor (2 tanks)	
Flow meter (2 tanks)	
SYSTEMS	
Construction of sub-surface system 200m^3	
transfer water to 2 tanks	
Fertilize by composting on-site green material	
IRRIGATION	
Transfer water to irrigate 0,4ha oregano	

Use of pump station	
Water rate flow (m^3/h)	
Electric power	
Controller	
Irrigation system-masonry type-equipment	
SOFTWARE	
GUI (graphic user interface)	
Time	
Alerts	
Connectivity	
users	
Control mechanism	
OTHERS	

Table 6.3: HYDRO 4

SENSORS	
Turbidity 1 (untreated before filtering- if possible)	
Turbidity 2 Treated water Probe immersed within Tank	
Conductivity 1- Treated Water immersed in Tank	
pH Aquifer (4 wells)	
Conductivity 2- Aquifer (4 wells)	
Controller	
Head node	
Weather station	
Peripheral nodes	
Soil Moisture sensors	
Solenoid valve (It depends the irrigation system used)	
Tank level sensor	
Flow meter	
Low cost sensors	
SYSTEMS	
Existing harvesting system (2 tanks $70m^3$-$40m^3$)	
Upgrade system: water from 400m2 roof area	
Recharge water into aquifer 4 wells	
Producing potable water- slow sand filtration	
Fertilize by composting on-site green material	

Cistern	
IRRIGATION	
Transfer water to irrigate 0.2ha lavender	
Use of pump_pump station	
Water rate flow (m^3/h)	
Electric power	
Controller	
Irrigation system- masonry type- equipment	
SOFTWARE	
GUI (graphic user interface)	
Time	
Alerts	
connectivity	
Users	
Control mechanism	
OTHERS	

Table 6.4: HYDRO 5

SENSORS	
Conductivity 1 seawater	
Conductivity 2 brine water	
Conductivity 3 final water	
pH 1 seawater	
pH 2 final water	
Turbidity final water	
Controller	
Head node	
Weather station	
Soil moisture sensors	
Solenoid valve (It depends the irrigation system used)	
Tank level sensor	
Flow meter	
SYSTEMS	
Connection with the existing desalination plant	
Construction of 200m^2 “Greenhouse mangrove”	
Cultivation of tropical fruits	
Clean water production	
Edible salt production	
Basic Water Source	
IRRIGATION	

Irrigate inside the greenhouse_tropical fruit	
Use of pupm_pump station	
Water rate flow (m^3/h)	
Electric power	
Controller	
Irrigation system- equipment	
SOFTWARE	
GUI (graphic user interface)	
Time	
Alerts	
Connectivity	
Users	
Control mechanism	
OTHERS	

Table 6.5: HYDRO 6

SENSORS	
Turbidity 1 (final outlet water)	
Turbidity 2 (final outlet wastewater)	
Soluble COD (wastewater outlet)	
pH 1 (final outlet water)	
pH2 (final outlet wastewater)	
Conductivity 1 (final outlet water)	
Conductivity 1 (final outlet wastewater)	
E. coli final water	
Controller	
Head node	
Weather station	
Soil moisture sensors	
Solenoid valve (it depends the irrigation system used)	
Tank level sensor	
Flow meter	
Low cost other sensors	
SYSTEMS	
Establishment of “Vapour condensation”_drinking water production	
Treatment of the liquid part of wastewater_reed beds	
Construction of a cistern	

Installation of 2 solar driven condensation unit	
Use of renewable energy (PV- battery system)	
IRRIGATION	
Irrigate 0.15 ha of local crops with reclaimed water	
Use of pump_pump station	
Water rate flow (m^3/h)	
Electric power	
Controller	
Irrigation system- equipment	
SOFTWARE	
GUI (graphic user interface)	
Time	
Alerts	
Connectivity	
Users	
Control mechanism	
OTHERS	

6.2 ANNEX II – Focus Group Questionnaire

Q1	**Name**	
Q2	**Organization**	

GENERAL INFORMATION	
Q3	**What services related to HYDROUSA you are using?**
Q4	**What type of device(s)/sensor(s) do you use with them?**
Q5	**Which are the reason(s) for using them?**

HYDROUSA PLATFORM DEVELOPMENT				
Q6	**What type of alerts would you like to receive from the HUDROUSA platform?**			
	SMS ☐	Email ☐	In-platform Notifications ☐	Other ………………… ☐
Q7	**Please rate the following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 being the least important and 5 the most important.**			

Information presented as:	**Not Important**	**2**	**3**	**4**	**Very Important**

	1				5
Maps	☐	☐	☐	☐	☐
Reports	☐	☐	☐	☐	☐
Statistics	☐	☐	☐	☐	☐
Charts	☐	☐	☐	☐	☐
Alerts	☐	☐	☐	☐	☐
Other ……..	☐	☐	☐	☐	☐

Q8	**In what file type(s) should the results be exported** (e.g. CSV, SHAPEFILE, TEXT)**?**	
Q9	**Would you like to be able to access historical information?**	
	Yes ☐	No ☐
Q10	**Would you like to be able to change the alert levels according to your needs?**	
	Yes ☐	No ☐
Q11	**Why would you like to be able to change the alert levels according to your needs?**	
Q12	**Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?**	
	Yes ☐	No ☐
Q13	**Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?**	
Q14	**Which type of measurements are mandatory for your needs?**	

Q15	**Which type of alerts are mandatory for your needs?**
Q16	**Other comments**

6.3 ANNEX III – Focus Groups Answers (Per Partner)

Table 6.6: ICRA

Q1	**Name**	
Q2	**Organization**	ICRA

QUESTIONS	PERSON 1	PERSON 2
Q3 What services related to HYDROUSA you are using?	Number of hospitals in the area? Number of industries in the area?, population discharging in the …? -> general information to be collected, Weather information	KPIs related to water quality (water treatment)/Weather characteristics
Q4 What type of device(s)/sensor(s) do you use with them?	-	We do not use sensors directly but interested in the information
Q5 Which are the reason(s) for using them?	-	-
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail	E-mail & in-platform notifications
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 3 REPORTS 4 STATISTICS 4 CHATS 5 ALERTS 3 OTHER -	MAPS 3 REPORTS 4 STATISTICS 5 CHATS 5 ALERTS 3 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV	CSV
Q9 Would you like to be able to access historical information?	YES	YES
Q10 Would you like to be able to change the alert levels according to your needs?	NO	NO
Q11 Why would you like to be able to change the alert levels according to your needs?	-	-
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO	NO
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	-	-

Q14 Which type of measurements are mandatory for your needs?	pH, conductivity, salinity, flow, Ta, DOU	Water/wastewater quality as much as possible (pH, T, Conductivity) flows (To estimate HRT, etc.)
Q15 Which type of alerts are mandatory for your needs?	-	If the systems have no water entering, if flows much higher than normal, Alerts also in terms of temperature, pH, etc., Affecting biological based systems
Q16 Other comments	-	-

Table 6.7: NTUA

Q1	**Name**		
Q2	**Organization**	NTUA	
QUESTIONS		**PERSON 1**	**PERSON 2**
Q3 What services related to HYDROUSA you are using?		Design of HYDRO 1 system monitoring	HYDRO1 - treated wastewater to agroforestry
Q4 What type of device(s)/sensor(s) do you use with them?		Monitoring wastewater treatment efficient and compliance with limits / for example DO, pH, conductivity, NO3-N, etc.	Commercial probes measuring physicochemical parameters (e.g. DO, pH, redox, NH4, COD etc.), Flow meters, level meters
Q5 Which are the reason(s) for using them?		To optimize the performance of the system, to collect data on systems performance, to control the operation of the system, to evaluate and verify efficient compliance	Checking compliance with limits, monitoring process efficiency (evaluation), Automate /Control part of the process
Q6 What type of alerts would you like to receive from HYDROUSA platform?		SMS & In-platform notifications	SMS, E-mails & In-platform notifications
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS		MAPS 0 REPORTS 3 STATISTICS 3 CHATS 5 ALERTS 3 OTHER -	MAPS 0 REPORTS - STATISTICS 5 CHATS 5 ALERTS 5 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?		Excel or CSV	CSV
Q9 Would you like to be able to access historical information?		YES	YES

Q10 Would you like to be able to change the alert levels according to your needs?	YES (depending on treatment performance)	YES
Q11 Why would you like to be able to change the alert levels according to your needs?	Depending on treatment performance	Check alternative ways of operation
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	YES	YES
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	In order to correlate performance with on line monitoring parameters	Check for correlation between parameters, calculate flows, performance indices
Q14 Which type of measurements are mandatory for your needs?	Flow, Level of water in tanks, waste water quality parameters (for example pH, conductivity, NO_3-N, UV	Commercial probes measuring physicochemical parameters (e.g. DO, pH, redox, NH_4, COD etc.), Flow meters, level meters
Q15 Which type of alerts are mandatory for your needs?	flow, wastewater quality parameters, levels	Alerts on water level, Alerts on not compliance with efficient (e.g. not to feed treated wastewater to Hydro 2)
Q16 Other comments	-	-

Table 6.8: MINAVRA

Q1	**Name**	
Q2	**Organization**	MINAVRA

QUESTIONS	**PERSON 1**
Q3 What services related to HYDROUSA you are using?	Irrigation, wastewater treatment plant systems we are actually build the systems and we don't gather data, DEYAL is responsible for this
Q4 What type of device(s)/sensor(s) do you use with them?	Automation, PLC, SCADA pumps
Q5 Which are the reason(s) for using them?	common use
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 5 REPORTS 2 STATISTICS 5 CHATS 5 ALERTS 3 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	Excel, Word, PDF, DXF

Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	NO
Q11 Why would you like to be able to change the alert levels according to your needs?	-
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	-
Q14 Which type of measurements are mandatory for your needs?	-
Q15 Which type of alerts are mandatory for your needs?	-
Q16 Other comments	-

Table 6.9: UNIVPM

Q1	**Name**	
Q2	**Organization**	UNIVPM

QUESTIONS	PERSON 1
Q3 What services related to HYDROUSA you are using?	Energy consumption water influent/ effluent, Water quality data, flow rate data, environmental/weather conditions, biogas quality
Q4 What type of device(s)/sensor(s) do you use with them?	conventional /commercial (low-cost) devices and sensors
Q5 Which are the reason(s) for using them?	we are measuring common parameters (no need for innovate (high-cost) sensors)
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail & In-platform notifications
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 5 REPORTS 3 STATISTICS 4 CHATS 5 ALERTS 4 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	NO
Q11 Why would you like to be able to change the alert levels according to your needs?	-

Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	YES
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	To evaluate replicability in different conditions
Q14 Which type of measurements are mandatory for your needs?	Energy consumption water influent/ effluent, Water quality data, flow rate data, environmental/weather conditions, biogas quality
Q15 Which type of alerts are mandatory for your needs?	sensors / probes/ meters out of range or out of operation /service
Q16 Other comments	-

Table 6.10: IRIDEA SRL

Q1	**Name**	
Q2	**Organization**	IRIDEA SRL

QUESTIONS	PERSON 1
Q3 What services related to HYDROUSA you are using?	Monitoring tools
Q4 What type of device(s)/sensor(s) do you use with them?	cod online probes , Ammonia & Nitrates electrochemical probes, pH, T, land, Q, DO
Q5 Which are the reason(s) for using them?	For understanding whether we fail the treatment design
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail & In-platform notifications
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 4 REPORTS 3 STATISTICS 5 CHATS 4 ALERTS 2 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV &Shape file
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	YES
Q11 Why would you like to be able to change the alert levels according to your needs?	If I get too many alerts, I could decide to rise up the alerts level
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO

Q14 Which type of measurements are mandatory for your needs?	-
Q15 Which type of alerts are mandatory for your needs?	Pollutants concentrations (mg/l)
Q16 Other comments	When concentrations are over the regulation limits

Table 6.11: BRUNEL UNIVERSITY

Q1	**Name**	
Q2	**Organization**	BRUNEL UNIVERSITY

QUESTIONS	PERSON 1
Q3 What services related to HYDROUSA you are using?	KPIs, environmental, economic assessment, social impact analysis, water-food-energy nexus, circularity assessment, ETU
Q4 What type of device(s)/sensor(s) do you use with them?	TOOLS -> MFA, LCA, LCC, off-line and sensor data, data from PLS and balance
Q5 Which are the reason(s) for using them?	For mapping the current and HYDROUSA system services, develop the food-water -energy nexus, validate our systems and HYDROUSA, draft the model
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail & in-platform notifications
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 5 REPORTS 5 STATISTICS 5 CHATS 5 ALERTS 5 OTHER 5
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV, shape file & text
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	NO
Q11 Why would you like to be able to change the alert levels according to your needs?	We need data to be provided in a specific form in order to feed our models. However, we would like to have the option to change the alert levels if needed.
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	YES
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	Integrate KPIs and algorithms to our model
Q14 Which type of measurements are mandatory for your needs?	energy, water (quality and quantity of nutrients), material flows

Q15 Which type of alerts are mandatory for your needs?	N/A
Q16 Other comments	-

Table 6.12: SATISTICA

Q1	**Name**	
Q2	**Organization**	SATISTICA

QUESTIONS	PERSON 1
Q3 What services related to HYDROUSA you are using?	Data services, access sites to collect information
Q4 What type of device(s)/sensor(s) do you use with them?	PLC, software application, database movement system, environmental SCADA system
Q5 Which are the reason(s) for using them?	To obtain data and create performance measures. Translate data into KPIs and track and traceability
Q6 What type of alerts would you like to receive from HYDROUSA platform?	In-platform notifications & Other
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 5 REPORTS 5 STATISTICS 5 CHATS 5 ALERTS 5 OTHER 5 (raw data)
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV & Text
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	NO
Q11 Why would you like to be able to change the alert levels according to your needs?	Potentially breakdown equipment
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	YES
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	We are tasked in the project to add value to the data and create knowledge on KPIs and FAT
Q14 Which type of measurements are mandatory for your needs?	All data collected from the plants and farms. Information on product track and traceability conducted in the field and supply chain.
Q15 Which type of alerts are mandatory for your needs?	Equipment state and breakdown
Q16 Other comments	-

Table 6.13: ELT

Q1	**Name**	
Q2	**Organization**	ELT

QUESTIONS	PERSON 1
Q3 What services related to HYDROUSA you are using?	Greenhouse control, irrigation control (open sprinklers), mechanic flow meters, weather station, photovoltaic monitoring
Q4 What type of device(s)/sensor(s) do you use with them?	-
Q5 Which are the reason(s) for using them?	open sprinkler = its open source and very good interface extendable, ongoing development driven by community, greenhouse = controlling windows, humidity, temperature
Q6 What type of alerts would you like to receive from HYDROUSA platform?	In-platform notifications & Other (display on device)
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 3 REPORTS 5 STATISTICS 5 CHATS 5 ALERTS 3 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	YES
Q11 Why would you like to be able to change the alert levels according to your needs?	in order to react to changing parameters
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	YES
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	In order to adapt the changing needs in crop cultivation levels
Q14 Which type of measurements are mandatory for your needs?	Water level, temperature, humidity, wind speed, direction, soil humidity, volts, actuator states, pH, EC, precipitation
Q15 Which type of alerts are mandatory for your needs?	Low/High Task Level, Low/high temp + pH +EC
Q16 Other comments	Very good documentation of: Hardware setup, software, commented code, community form platform for future development by a community

Table 6.14: IHA

Q1	**Name**	

Q2	**Organization**	IHA

QUESTIONS	**PERSON 1**
Q3 What services related to HYDROUSA you are using?	Community buildings and techniques, Social impact analysis, Facebook, Linked In, Twitter, YouTube
Q4 What type of device(s)/sensor(s) do you use with them?	Mobile phone applications, Push notifications, computers
Q5 Which are the reason(s) for using them?	get info, communication (external & internal), Identify trends
Q6 What type of alerts would you like to receive from HYDROUSA platform?	SMS, E-mail & Other (display on device)
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 4 REPORTS 4 STATISTICS 5 CHATS 5 ALERTS 4 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV & Excel
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	NO
Q11 Why would you like to be able to change the alert levels according to your needs?	-
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	-
Q14 Which type of measurements are mandatory for your needs?	-
Q15 Which type of alerts are mandatory for your needs?	-
Q16 Other comments	-

Table 6.15: AERIS

Q1	**Name**	
Q2	**Organization**	AERIS

QUESTIONS	**PERSON 1**
Q3 What services related to HYDROUSA you are using?	UASB reactor -anaerobic digestion systems, monitoring and control sensors/devices, territory treatment

Q4 What type of device(s)/sensor(s) do you use with them?	Pressure, level, temperature, redox, pH, Biogas flow rate, Water flow rate, biogas production turbidity
Q5 Which are the reason(s) for using them?	Reliability/stability, turbidity
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 4 REPORTS 5 STATISTICS 4 CHATS 5 ALERTS 5 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	Excel
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	YES
Q11 Why would you like to be able to change the alert levels according to your needs?	To be able to rapidly actuate in case of system malfunction
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	-
Q14 Which type of measurements are mandatory for your needs?	Pressure, level, temperature, redox, pH, Biogas flow rate, Water flow rate, biogas production turbidity
Q15 Which type of alerts are mandatory for your needs?	HH and LL alerts for all signals exposed in Q4
Q16 Other comments	-

Table 6.16: ALCN

Q1	**Name**	
Q2	**Organization**	ALCN

QUESTIONS	PERSON 1
Q3 What services related to HYDROUSA you are using?	Composting, water condensation, water evaporation, constructed threshold
Q4 What type of device(s)/sensor(s) do you use with them?	Temperature, Conductivity, humidity, COD, BOD, turbidity, TSS, pH, T, microbes (E. coli)
Q5 Which are the reason(s) for using them?	Checking water quality and system conditions, water quality and decision triggers
Q6 What type of alerts would you like to receive from HYDROUSA platform?	In-platform notifications
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1	MAPS 2 REPORTS 3

to 5, with 1 the least important and 5 the most important. MAPS	STATISTICS 4 CHATS 5 ALERTS 5 OTHER 5 (controlling)
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	YES
Q11 Why would you like to be able to change the alert levels according to your needs?	To be able to "play" with the systems and realise their limits
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	YES
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	To be able to trigger actuators (like values) automatically
Q14 Which type of measurements are mandatory for your needs?	Temperature, conductivity, humidity, turbidity
Q15 Which type of alerts are mandatory for your needs?	conductivity/above threshold, humidity/temp -> open window / valve/pump, turbidity above threshold-> send water back (valve/pump)
Q16 Other comments	-

Table 6.17: PLENUM

Q1	**Name**	
Q2	**Organization**	PLENUM

QUESTIONS	**PERSON 1**
Q3 What services related to HYDROUSA you are using?	Google drive, zoom online calls, skype
Q4 What type of device(s)/sensor(s) do you use with them?	-
Q5 Which are the reason(s) for using them?	-
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail, In-platform notifications & Other (Facebook postings)
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 5 REPORTS 4 STATISTICS 5 CHATS 5 ALERTS 4 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	CSV & Text

Q9 Would you like to be able to access historical information?	NO
Q10 Would you like to be able to change the alert levels according to your needs?	YES
Q11 Why would you like to be able to change the alert levels according to your needs?	Not all information is addressing me, in terms of project management
Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	-
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	-
Q14 Which type of measurements are mandatory for your needs?	carbon footprint of produced unit, water footprint
Q15 Which type of alerts are mandatory for your needs?	-
Q16 Other comments	-

Table 6.18: MUNICIPALITY OF TINOS

Q1	**Name**	
Q2	**Organization**	MUNICIPALITY OF TINOS

QUESTIONS	PERSON 1
Q3 What services related to HYDROUSA you are using?	Weatherlink software
Q4 What type of device(s)/sensor(s) do you use with them?	-
Q5 Which are the reason(s) for using them?	Control and monitoring weather stations (DAVIS)
Q6 What type of alerts would you like to receive from HYDROUSA platform?	E-mail & in-platform notifications
Q7 Please rate following ways of displaying the information from the HYDROUSA platform from 1 to 5, with 1 the least important and 5 the most important. MAPS	MAPS 5 REPORTS 3 STATISTICS 5 CHATS 4 ALERTS 2 OTHER -
Q8 In what file type should the results be exported (e.g. CSV, SHAPEFILE, TXT)?	Shapefile
Q9 Would you like to be able to access historical information?	YES
Q10 Would you like to be able to change the alert levels according to your needs?	YES
Q11 Why would you like to be able to change the alert levels according to your needs?	YES

Q12 Would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO
Q13 Why would you like to have the ability to create custom algorithms on top of the HYDROUSA platform?	NO
Q14 Which type of measurements are mandatory for your needs?	-
Q15 Which type of alerts are mandatory for your needs?	Temperature and Rain alerts
Q16 Other comments	-