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Project deliverables

Deliverable #D2.1

Matrix of feasibility criteria for managed aquifer recharge

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PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

AGREEMAR

Adaptive agreements on benefits sharing for managed aquifer recharge in the Mediterranean region

Deliverable #D2.1

Matrix of feasibility criteria for managed aquifer recharge

Author(s)

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Executive summary

Deliverable D2.1 is dedicated to the compilation of an extensive database containing hydrogeological, geochemical, biophysical, environmental, social, economic feasibility criteria for managed aquifer recharge. These criteria were collected from peer-reviewed journal articles, conference papers, technical reports, and stakeholders interviews. A four-level classification system has been proposed, calibrated and validated by consortium partners and through online questionnaires and interviews with selected MAR experts. The matrix of feasibility criteria is a "living document", to be continuously updated during the project. The current version can be downloaded from the following address: https://agreemar.inowas.com/feasibility-criteria/.

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0.1	24.10.2022	Constantinos Panagiotou (ECoE)	First complete draft of the deliverable
0.2	27.10.2022	Constantinos Panagiotou (ECoE)	Updated with comments from LNEC, INAT, UPV
0.3	30.10.2022	Constantinos Panagiotou (ECoE)	Updated with comments from adelphi
1.0	31.10.2022	Catalin Stefan (TUD)	Contributions and final revisions

Abstract

The purpose of this report is to introduce a database of feasibility criteria for managed aquifer recharge (MAR) that includes biophysical, technological, social, economic, environmental, hydrological, institutional and financial considerations. The database has been compiled by integrating data collected from journal articles, technical reports, and other publications, as well as from interviews with MAR experts. The information collected has been organized using a four-level hierarchical system: thematic, topic, category and criteria. The first level involves four thematic layers proposed for the geospatial MAR feasibility assessment: intrinsic conditions, water availability, water demand and non-physical considerations (social, economic, legislations, etc.). The structure of the feasibility matrix was revised according to feedback provided by consortium partners. Subsequently, online surveys and interviews with MAR experts provided additional suggestions and improvements.

During database compilation and validation, a series of general considerations were identified as very relevant for future studies on MAR site feasibility mapping. Most importantly, the important role of cross-sectoral stakeholders' engagement in all stages of feasibility mapping was highlighted. The feasibility maps were recognized as valuable tools to initiate and sustain interactions with stakeholders and support their decision-making processes. The four-step hierarchical level and the inclusion of additional non-intrinsic parameters was most welcomed although the advanced level of complexity and time consumption for criteria selection and processing might be challenging. Nevertheless, the importance of including non-physical considerations in the site feasibility mapping was also pointed out, even though they might not be directly measurable. An issue still open for further debate is the inclusion of the temporal dimension in an explicit manner within the feasibility matrix, especially in terms of reasonability, long term impact etc. In addition, the importance of providing rough estimations of some parameters was highlighted, even if a common resolution of the data for all parameters is not achieved. These estimations can assist in evaluating the influence of these parameters on the decision-making process.

Throughout the course of the project, the "living" database will be enhanced through additional responses from the MAR community and stakeholders using a multi-lingual online questionnaire, along with the interaction with regional and local stakeholders at the project demonstration sites. The resulting database will form the basis for the compilation of site-specific MAR feasibility maps in Portugal, Spain, Cyprus and Tunisia. Moreover, the database will serve as consolidated framework for further feasibility mapping studies, allowing for more convergence in MAR feasibility assessment within the scientific community.

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1. Introduction

1.1 Motivation and concept

Site suitability maps are widely used to rank the potential of different regions for MAR implementation depending on a set of thematic criteria. A review of over 60 cases of MAR suitability mapping (Sallwey et al., 2018) revealed that most studies are focusing only on intrinsic indicators, for example soil type, land use, geology, widely neglecting other technical and non-technical considerations.

Inclusion of additional aspects besides the intrinsic physical characteristics during the multi-criteria decision analysis can lead to a better understanding of the factors that affect the potential for MAR implementation, increasing the validity and outreach of the decision-making processes. Appropriate selection of regions where the implementation of MAR can be considered as feasible requires thorough identification of a larger pool of criteria relevant to MAR systems, especially related to an accurate estimation of the water demand, the qualitative and quantitative water availability for infiltration, the intrinsic site properties, as well as the socio-cultural and economic conditions.

Data availability and biased opinions of experts are also factors that affect the outcome of the analysis. Contribution of the stakeholders in all stages of the mapping process through a participatory approach can mitigate these adversities, increasing the validity of the outcomes that might be used for revising existing water policies and signing new agreements for water management.

1.2 Objective

The objective of this report focuses on the compilation of a feasibility criteria matrix that integrates biophysical, technological, social, economic, environmental, hydrological, institutional and financial parameters obtained from an extensive literature review and through stakeholders' interactions (interviews with MAR experts and online questionnaires).

1.3 Methodology

A set of sub-tasks has been followed for the completion of the MAR criteria matrix:

1. Determine the draft structure of the feasibility criteria matrix.
2. Conduct literature survey to collect information needed to characterize the feasibility of managed aquifer recharge based on biophysical, technological, social, economic, environmental, hydrological, institutional and financial parameters.
3. Incorporate the collected information into the feasibility criteria matrix according to the proposed structure.
4. Calibrate and validate the feasibility criteria matrix through an iterative process that involve consortium partners and external MAR experts.
5. Further improve the database through continuous engagement with the scientific community by using a dedicated online questionnaires and workshops.
6. Regularly update the database with suggestions and feedback received from stakeholders and the wider MAR community.

2. Spatial feasibility assessment

2.1 MAR objectives

The analysis of previous site suitability mapping studies revealed a general appetite of the authors for the compilation of some sort of universally valid MAR suitability maps. The maps tend to show areas that are *suitable for MAR*, considering MAR as a *specific technique to recharge the aquifers*. In reality, MAR is a general term that includes a bundle of techniques that can be used to address a very large variety of site-specific objectives. Such *one-map-that-fits-them-all* approach can be misleading, creating mistrust among stakeholders and slowing the development of MAR practices.

The AGREEMAR project recognized the crucial importance of clearly defining the MAR objectives before any delineation of promising regions for implementation. The specific infiltration technique itself (infiltration ponds, injection wells etc.) is not a strictly restrictive factor but the hydrogeological characteristics of the site are decisive in selecting a certain category of solutions (surface spreading for well-permeable soils, subsurface injection in case of poorly-permeable shallow layers, etc.).

The first step towards the compilation of site feasibility maps is therefore to carefully consider the range of recharge objectives, from which the primary and secondary objectives will be chosen and prioritized. This step is usually ignored in most site suitability mapping studies analysed, leading to publication of maps that are apparently generally available, for any purposes, under any conditions. At best, the MAR scheme planed on these areas will not provide the expected benefits that could otherwise be achieved, while in worst cases, the areas identified as feasible will be completely unsuitable, leading to technical failures and significant economic loses.

For the compilation of feasibility criteria matrix, a comprehensive list of 32 recharge objectives was considered (Table 1) based on MAR systems that operate in a global level (American Society of Civil Engineers, 2001). For each of the objectives, an initial set of feasibility indicators was drafted with the results being merged into a comprehensive database of technical and non-technical criteria.

Table 1. Recharge objectives of MAR projects under different development stages around the world

No.	Recharge Objective	No.	Recharge Objective
1	Integrated water management	17	Thermal energy storage
2	Seasonal storage and recovery of water	18	Stabilize aggressive water
3	Long-term storage, or water banking	19	Disinfection by-product reduction
4	Emergency storage, or strategic water reserve	20	Hydraulic control of contaminated water
5	Short-term storage	21	Nutrient reduction in agricultural runoff
6	Enhance well field production	22	Improve quality of surface water by soil-aquifer treatment
7	Restore ground water levels, replace overdraft	23	Reclaimed water storage for reuse.
8	Raise water levels, reduce pumping costs	24	Create barriers to salt water intrusion to stop, reverse, or prevent intrusion
9	Substitute for or supplement surface or pipeline distribution systems	25	Compensate for surface salinity barrier leakage losses
10	Maintain distribution system pressure and flow	26	Reduce environmental effects of stream flow diversions
11	Increase system reliability for pressure and flow	27	Protection and restoration of streamflow
12	Maintain floating fresh water lenses	28	Fish hatchery water temperature control
13	Defer construction or expansion of water facilities	29	Water recreation
14	Stop or reduce rate of land surface subsidence	30	Flood control
15	Improve ground water quality to agricultural standards	31	Fish and wildlife enhancement

No.	Recharge Objective	No.	Recharge Objective
16	Improve ground water quality to municipal standards	32	Protect aquatic and riparian habitat

Drafting the criteria matrix based on the list of objectives will be very beneficial also in the next step of the project where guidelines will be elaborated to support the authors of site feasibility maps to select a reasonable number of criteria. In this case, the approach will be reversed and, based on the selected objectives, a number of criteria will be suggested for the GIS-based maps compilation.

2.2 Hierarchical structure

The feasibility matrix aims at covering a wide range of aspects against which the plausible MAR sites can be compared. For that purpose, a four-level hierarchical structure has been proposed to classify the collected data. The first level involves the four major thematics of the feasibility assessment: a) intrinsic site suitability, b) water demand, c) water availability, and d) non-physical considerations (e.g., social, legal, governance economical etc.). For each thematic component, the relevant data is classified into three levels: topics, categories and criteria (Figure 1). This subsection provides a description on how the categories have been chosen for each topic, depending on the objective of the MAR project and the focus of the decision-making process. Data availability will also affect the selection of categories from the catalogue but this has been neglected at this stage as the compilation of a comprehensive database of feasibility criteria shall not be driven by data availability in the first place.

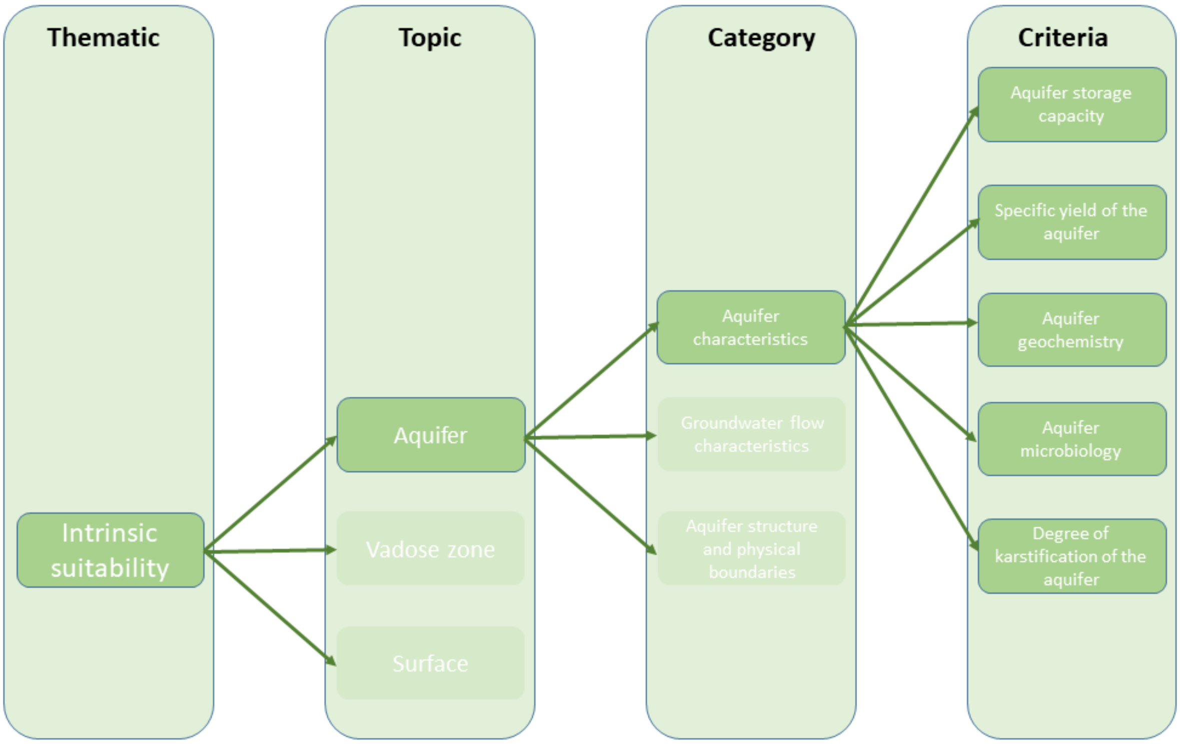

Figure 1. Example of the hierarchical structure of the feasibility matrix

2.3 Conceptualisation and content

This section will introduce each of the four main thematic areas considered by the project as relevant for MAR implementation: a) intrinsic site suitability, b) water demand, c) water availability, d) non-technical considerations. Please note that only three levels are presented in this report (thematic area, topic and category). Considering the living character of the database, the structure presented is not final and shall rather be considered as a general guideline that might change during the project duration, together with the list of feasibility criteria included in each category. The current version of the database can be downloaded from this address: https://agreemar.inowas.com/feasibility-criteria/.

2.3.1 Intrinsic site suitability

The thematic area of intrinsic site suitability contains information regarding the hydrogeological characteristics of the regions considered for MAR implementation. This group is organized into three topics: surface area, vadose zone and aquifer. Each of these topics contains a set of categories, which are used during the process of criteria selection to rank and identify sites intrinsically suitable for MAR (Table 2).

Table 2. Hierarchy levels for the thematic of intrinsic site suitability

Topic	Category	Description
Aquifer	Aquifer characteristics	Refers to major parameters that characterize the aquifer (e.g. storage capacity, specific yield, temperature geochemistry, microbiology, degree of karstification, storage capacity of the aquifer)
	Groundwater flow characteristics	Refers to the physical properties that dictate the groundwater movement (head gradient, speed, hydraulic conductivity)
	Aquifer structure and physical boundaries	Considers the aquifer geometry, lithology and lateral connections with other water bodies
Vadose zone	Groundwater table	Considers the thickness of vadose zone, the fluctuations of the groundwater table (intra-seasonal and inter-seasonal), and the infiltration capacity of the vadose zone
Surface area	Geomorphology	Refers to the land slope (affects the intensity of surface run-off and top-soil infiltration capacity)
	Hydrography	Refers to the drainage density (abundance of rivers and streams which may constitute favorable features for surface water infiltration)
	Land use / Land cover	Refers to the purposes for which land is used, as well as the area extent. Aquifer recharge depends from the existing land use / land cover
	Soil	Refers to top soil properties, e.g. texture, total organic carbon that directly impacts water infiltration
	Karst features	Refers to the density of surface karst features. In the case of karstic aquifers, these lineaments constitute the preferable pathways of the aquifer recharge

2.3.2 Availability of water for MAR

Next, the thematic associated with the availability of water resources for MAR implementation is considered (Table 3), which plays an essential role on determining the feasibility level of a potential MAR site. It considers both conventional and non-conventional water sources (e.g., wastewater, desalinated water), their qualitative composition (e.g., chemical pollutants, pathogens, turbidity, etc.), along with the impact of climate processes.

Table 3. Hierarchy levels for the thematic of water availability

Topic	Category	Description
Climatic context	Hydrometeorology	Refers to the natural water generated from processes of the hydrological cycle, such as precipitation, evapotranspiration and direct run-off
Source water	Source water quality	Refers to the quality of the source water (including pathogen, nutrients, salinity and sodicity, organic chemicals, turbidity and particulates, inorganic chemical concentrations, radionuclides) as well as proximity to contamination sources (see Australian Guidelines, 2009). The qualitative aspect of source water controls its use for MAR
	Source water availability	Refers to the amount of water available for MAR purposes (conventional and con-conventional sources), proximity to origin of water sources (including wadis and non-conventional sources), water supply connection density, surface water conveyance infrastructure and possible impact of climate change

2.3.3 Demand for MAR

The thematic of water demand is an essential component of integrated water management for achieving sustainable development. The classification was derived from the general approach of groundwater-dependent ecosystem services (ES) and included the main four ES clusters: provisioning, regulating, supporting and cultural. In brief: provisioning ecosystem services include human benefits that can be directly extracted from nature, such as food, drinking water, wood fuel etc. Regulating services includes ecosystem processes (e.g., bacteria decomposition, bees pollination, flood mitigation, prevention of soil erosion) associated with the mitigation of natural phenomena, thus allowing ecosystems to remain clean, sustainable and resilient to climate changes. Cultural services contribute to the cultural advancement of the people, the building of knowledge and ideas through the interaction with nature and recreation. Lastly, supporting services are needed for producing and maintaining the other three ecosystem services. These services involve natural processes such as soil formation and retention, biomass production, production of atmospheric oxygen. Table 4 presents the topics and categories chosen for this thematic, along with a brief description.

Table 4. Hierarchy levels for the thematic of water demand

Topic	Category	Description
Provisioning needs	Domestic supply	Refers to monthly (or seasonal) percentage of non-satisfied domestic demand by the existing water resource, the annual growth rate of domestic water supply and the water price
	Agricultural supply	Refers to the parameters controlling agricultural water consumption such as crop pattern, land covered/used for agricultural purposes, the annual growth/decline of industrial supply

Topic	Category	Description
	Industrial supply	Refers to the non-satisified amount of water allocated for industrial purposes
	Geothermal energy	Refers to the generated energy from geothermal water.
Regulatory needs	Buffering water quality	Refers to the rate of aquifer salinization and the variation of the groundwater chemistry (e.g. annual mean values, seasonal)
	Buffering water quantity	Refers to the flood risk (flood water might be harvested and injected to the aquifer), and the erosion risk (run-off water might be collected and injected to the aquifer) and natural groundwater recharge rate
Supporting needs	Groundwater dependent ecosystems	Refers to the required stream baseflow, springs discharge, the required water to maintain wetlands, phreatophytes, hyporheic zone dynamics
	Land surface suitability	Refers to the risk of land subsidence (MAR can reduce the risk of land subsidence)
Cultural needs	Hot springs	Refers to hot water abundance in hot springs, as well as the number of visitors of hot springs (high demand for hot spring water)
	Leisure and recreation	Refers to the required amount of water for leisure and recreation, as well as the number of site visitors for leisure and recreation

2.3.4 Non-physical considerations

The fourth thematic includes all non-physical considerations that are nonetheless relevant for the success of MAR schemes, such as legal and socio-economic aspects (Table 5).

Table 5. Hierarchy levels for the thematic that involves non-physical aspects of MAR

Topic	Category	Description
Governance constraints	Legal constraints	Legal constraints at national, European and international level
	Water rights	Refers to water rights for beneficiars, source water owner, land owners, acceptance of MAR owner by the local stakeholders, as well as the level of accountability in terms of legislations and public
	Trans-border issues	Refers to the existence of transboundary flows, as well as issues with downstream/upstream countries
	Political stability	Considers the presence of regional conflicts (in general), and the level of corruption (in all society levels)
Social constraints	Awareness of MAR	Considers the level of awareness for MAR practices, MAR acceptance (e.g.

Topic	Category	Description
		religion constraints), as well as priority of water allocation
	Vulnerability to groundwater supply	Refers to the poverty status, lingustic isolations and educational attainment
	Health	Considers the possible impact of MAR facility on population health
	Social capital	Refers to social participation/involvement in MAR implementation
Environmental constraints	On optical aesthetics during the construction stage	Distance of MAR to other types of infrastructure, especially sensitive landscape (e.g., wetlands, etc.)
	On emissions	Refers to emission during construction (dust and carbon emissions; liquid wastes from paints and machinery during the construction period), risk of Insect proliferation
	Cultural heritage	Refers to the risks of MAR on archeological sites/objects
Economic constraints	Investment costs	Cost of preliminary studies, water abstraction, water transfer, recharge water, land acquisition, infiltration basins (see also Maréchal et al. 2020)
	Operating costs	Refers to the cost of water purchase during operating phase of MAR, cost of maintenance and uptake during operating phase of MAR, cost of energy during operating phase of MAR, cost of pre-treatment operation during operating phase of MAR, cost of monitoring during operating phase of MAR, and other annual expenses during operating phase of MAR (see also Maréchal et al. 2020)
	Levelized costs	Refers to the levelized cost: maintenance cost-recharge
Infrastructural constraints	Accessibility	Refers to the accessibility network to MAR facility
	Communications	Refers to the communication systems with and within MAR facility
	Safety of the workers and users	Considers the water level of the recharge ponds in relation to workers and users' safety, electricity contact with operating system in relation to workers and users' safety

2.4 Database validation and continuous improvement

A methodology was adopted to reduce the bias and improve the quality of the database. This included the development of a multi-lingual online survey (English, Spanish, Portuguese, French and Arabic) and a set of dedicated interviews. The online survey contains a wider range of questions that are used to assess also the needs of the scientific community and stakeholders involved with MAR and to collect feedback on the proposed feasibility matrix while the direct interviews are targeted at MAR experts that are familiar with MAR feasibility mapping. The survey will remain online during the entire duration of the project and the results will be used to produce an improved monthly update of the feasibility matrix.

2.4.1 Validation and improvements through online survey

The specific objective of the online survey is to introduce the AGREEMAR's approach to a wider scientific community and to collect feedback regarding the AGREEMAR proposal for a widely accepted methodology for MAR feasibility mapping.

To further enhance the feasibility matrix, an online questionnaire has been compiled that involves a large set of criteria that have been associated with each one of the categories described in Section 2.4. Each participant of the questionnaire (Figure 2) needs to fulfill the following steps:

- Step 1: The participant is asked to provide basic information about his educational level, language, area of expertise, participant institution sector, etc.
- Step 2: This step considers the current status of the MAR applicability at the country of the participant, the most relevant stakeholders involved in the MAR practices, and attempts to identify the major recharge objectives that can be addressed by MAR.
- Step 3: The participant is asked to provide comments regarding the four-level classification system (thematics, topics, categories and criteria).
- Step 4: The participant is requested to rank a set of criteria for each thematic layer, and suggest additional criteria that should have been included.

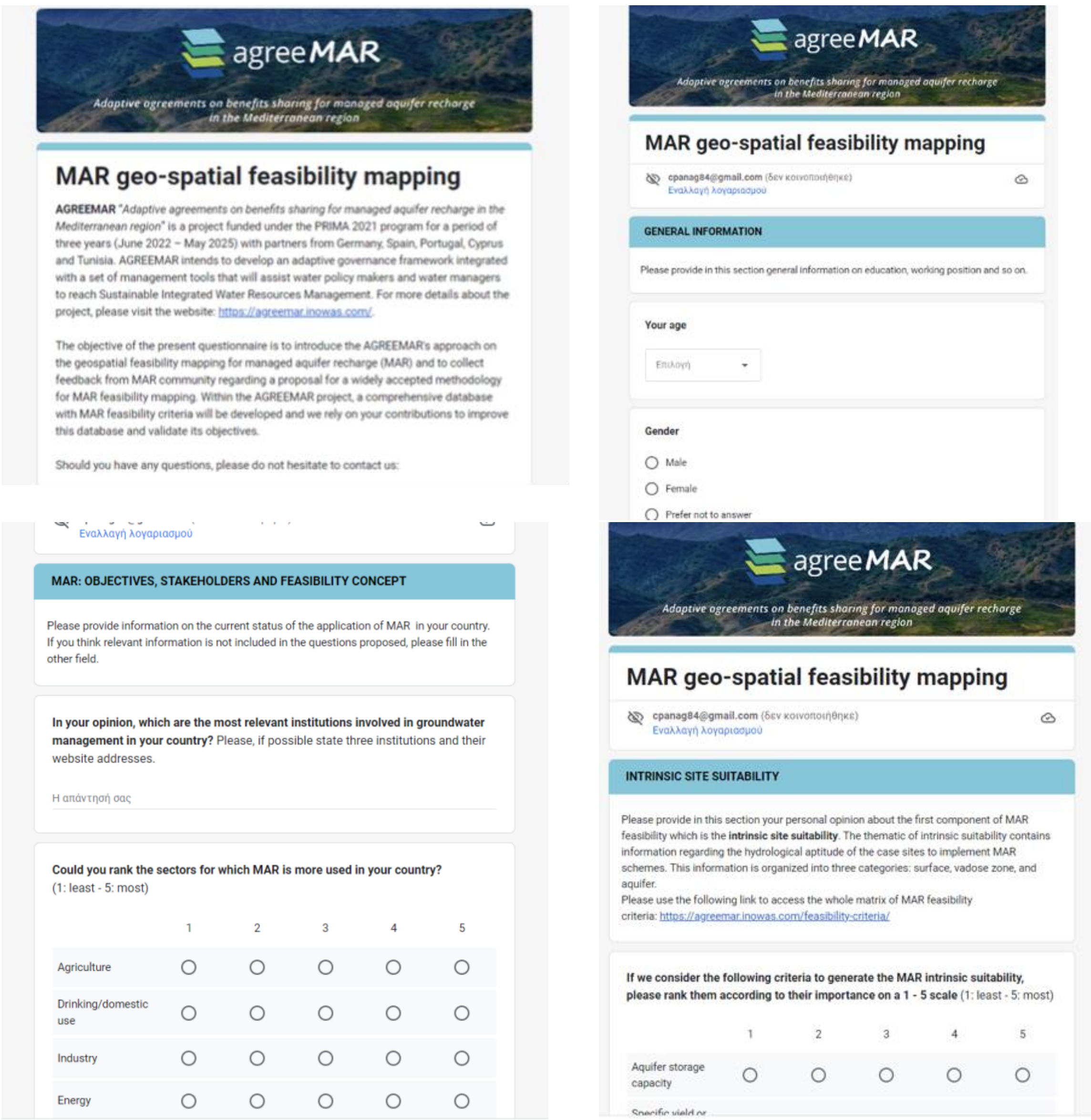

Figure 2. Screenshots from the online questionnaire on the geo-spatial feasibility mapping

Firstly, the online questionnaire has been answered by the consortium partners, from which a revised version has been compiled, and distributed within the MAR community via the following link: https://agreemar.inowas.com/feasibility-criteria/. To facilitate the involvement of local stakeholders, the questionnaire has been translated by the consortium partners into five languages: Portuguese, Spanish, French, Arabic, German and Greek.

2.4.2 Validation and improvements through stakeholder interviews

A number of online interviews (Figure *3*) has been conducted by Dr. Constantinos Panagiotou (ECoE) and Dr. Catalin Stefan (TUD) that focuses on the following group of people:

- experts on MAR who conducted site suitability mapping
- experts on MAR who are closely involved in planning and construction of MAR schemes
- MAR experts in a wider sense

The responses of the MAR experts are expected to contribute on the following tasks:

- validation and/or extension of the current lists of criteria, validate and possibly extend the lists
- validation of the four-map approach and refinement of the proposed methodology
- exploration of options to include the time factor within the feasibility matrix
- further development of the general methodological approach and scope

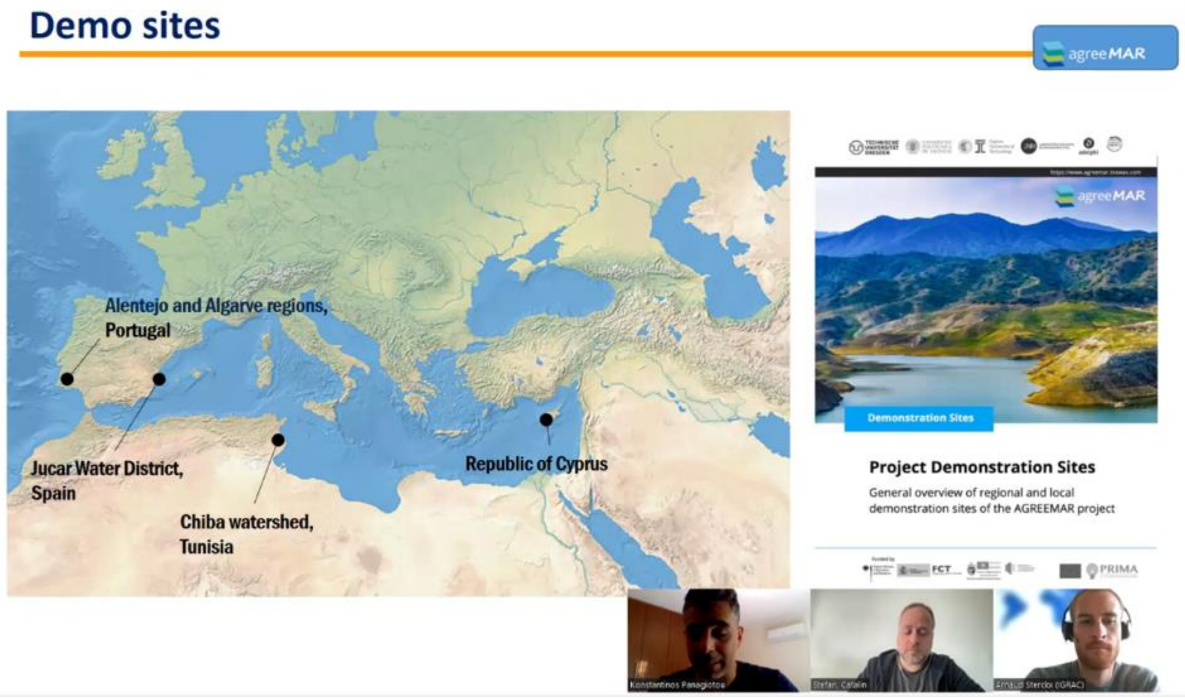

Figure 3. Photos taken during online interviews with MAR experts that took place in October, 2022

Table 6 shows the list of questions that has been addressed during the discussion with the interviewees, along with their main feedbacks.

Table 6. Interview questions and feedback from the interviewees

Questions	Major feedback from the interviewees
• Our aim is to compile a database that will contain an extensive amount of information relevant to MAR implementation. Which do you think are the proper tools, methodologies, sources that we should use for that purpose?	• Firstly, a list that describes the needs for making an informed decision about locating a MAR site has to be prepared. This list will be used to identify what type of information is required to address these needs (recharge objectives). • Contact water supply companies to collect data that are not available online. • Emphasize the role that stakeholders can play during the process of data collection. • Experience from previous projects on MAR suitability mapping revealed that looking for data commonly available can be a challenging task, because the availability of the data is different in each country. • Finding a common resolution among the different case studies is another challenge. Its importance is depended on the scaling of the recharge objective, especially for local applications. Nevertheless, providing even rough estimations of some parameters can assist on evaluating their influence on the decision-making process. • Even if some of the selected criteria are not available, it still makes sense to make a potential suitability mapping. For example, identifying from the available data which parts of the study area are unsuitable, thus reducing the efforts for finding suitable regions for MAR implementation. • Interaction between stakeholders and researchers can help on identifying additional issues for which MAR can be used.
• The collected information has been organized into four hierarchy levels, called thematics: intrinsic, water availability, water demand and non-physical (social, economic, legislative, etc.) which might not be directly measurable. In your opinion, is this an efficient way to allocate this information?	• Even though criteria related to non-physical indicators might not be directly measurable, they should be incorporated in the decision-making process. Criteria of this thematic can be thought separately from the other three thematics (intrinsic, water availability and water demand).
• Based on the four-level hierarchy level, we have proposed relevant categories for mapping the MAR feasibility of sites. What are the limitations and advantages of adopting such approach?	• All experts were satisfied with the four-level hierarchy level, although it was pointed out that the criteria selection process can be time consuming due to the large amount of information. However, the proposed classification system can provide in-depth understanding of the MAR-relevant processes.
• During the development of the database, we have considered to include criteria into different groups. Is this reasonable to do, or shall we avoid proposing duplicate criteria?	• It was suggested that this is not an issue if multiple criteria share the same name, as long they are thought from a different perspective. It was highlighted the importance of avoiding situations where two different criteria are overlapping in large extent (e.g., transmissivity and hydraulic conductivity).
• How do you suggest we include the impact of time factor (e.g., seasonality, long-term impact) within the feasibility mapping? What about the different time scales?	• It was characterized as a challenging task from a practical point of view, especially since the proposed approach has already a certain level of complexity.

Questions	Major feedback from the interviewees
• From your experience, what adaptations are required so that the proposed approach (selection criteria process, weighting system) can be acceptable by the decision makers? Shall we include additional steps during this process that further involve the stakeholders?	• The main benefit of applying this approach is not the compilation of the feasibility map itself as the final output, but the understanding about the groundwater system, about the case study, that is gained in the process of making the map. • The feasibility map will reflect the valuable lessons that have been gained during this process, which should be shared with the stakeholders to assist further discussions on achieving optimal decisions. • Propose that the final product could provide to the users' information on how certain parameters can influence the area extent in which suitable regions can be identified. So, these parameters, in the future probably should be even more investigated. • All interviewees emphasized the importance of the active participation of the stakeholders in all the steps of applying MAR feasibility mapping. This is a good way to secure their engagement and commitment in the development and validation of the feasibility maps, as well as in the decision-making process.

2.4.3 Further steps

To further enhance the feasibility matrix and validate the proposed methodology, additional interviews and online surveys will be conducted during the entire period of the project with stakeholders that possess knowledge on MAR systems and suitability mapping. Both will be updated in a monthly basis according to new feedback from consortium partners, local stakeholders and MAR experts. Additional contributions to the database are expected during the physical meetings with local stakeholders at Portugal, Spain, Tunisia and Cyprus, which will take place in the forthcoming months.

3. Summary and conclusions

An extensive survey that involved peer-reviewed articles, conference papers, technical reports and interviews with MAR experts, has been conducted to collect information relevant to recharge objectives derived from MAR projects currently in operation or in various development stages around the world. The collected information was used to compile the feasibility matrix, which consists of a four-level hierarchical system: thematic, topic, category and criteria. The first level involves four thematic layers, which have been proposed to assess the MAR suitability and feasibility of the sites, particularly intrinsic, water availability, water demand and non-physical (social, economic, legislations, etc.).

Initially, the structure of the feasibility matrix was revised according to feedback provided from all consortium partners. Subsequently, online surveys and interviews with MAR experts were conducted that provided additional modifications and suggestions for further improvements. These activities are part of an iterative process that will be active during the entire period of the project.

A list of questions was prepared by consortium members and used to coordinate the online interviews with MAR experts. All experts highlighted the positive role that the stakeholders can have in all stages of the feasibility mapping, as well as in the decision-making process. They considered the feasibility map as a valuable tool for initiating a discussion with the policy makers for achieving optimal water management. The four-step hierarchical level was validated by all interviewees, although some of them argued that it possesses a certain level of complexity and the criteria selection is expected to be time-consuming due to the large number of information that needs to be processed.

Regarding the non-physical thematic, the importance of including non-physical considerations in the decision-making process was pointed out, even though they might not be directly measurable. Inclusion of temporal information in an explicit manner within the feasibility matrix has been characterized as a challenging task from a practical point of view, as well as the collection of data commonly available for each country. The importance of providing rough estimations of some parameters was highlighted, even if no common resolution of the data is achieved for all parameters, since these estimations can assist on evaluating the influence of these parameters on the decision-making process. An additional comment was to assess the impact that certain criteria have on the area extent which includes the potential MAR sites.

The resulting database will form the basis for stakeholder engagement within the AGREEMAR project and beyond. It will be used for the identification of the most important criteria (specific to the MAR system) during the forthcoming meetings with the local stakeholders (WP3). A weighting system will be developed that displays the relevance of each indicator for each stakeholder cluster (D2.2). Accordingly, multi-criteria decision analysis will be applied on the selected indicators to map the MAR feasibility for each case study region (D2.3).

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