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Identification of stakeholders and quality needs for water

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Contents

1. Introduction

The current deliverable, Identification of Stakeholder and Quality Needs for Water (2.1), aims to identify the end users or stakeholders of reclaimed water in the SUDOE region, evaluate their needs, and identify the existing barriers to the use of reclaimed waters in the region. With a project strategy based on a "fit-for-purpose" approach to water reuse, this deliverable is of particular importance for the development of this project.

Though the three countries in the SUDOE region share many commonalities, each of them has its own context to consider when it comes to analysing the needs of their respective stakeholders. In particular, there exist many differences regarding agricultural practices, urban management and management of water between the three countries that must be explained and considered before analysing the feedback received from stakeholders. This introduction will serve to set the general scope of this deliverable, as well as to provide the information required to highlight the differences in organisation between the three SUDOE countries. This will, in turn, help us to better understand the needs of the stakeholders in the SUDOE region, which is the primary goal of this deliverable.

1.1. Portuguese context

In Portugal, Decree-Law No. 119/2019, of August 21, establishes the legal framework for the production of water for reuse (ApR), obtained from the treatment of wastewater, as well as its use for non-potable purposes. This decree addressed gaps in the quality criteria for ApR, setting requirements for quality standards, monitoring procedures, and key risk management tasks associated with its use. The legislation

follows a "fit-for-purpose" approach, ensuring that ApR quality is adapted to each specific application, with defined quality standards for irrigation, urban, and industrial uses.

The case study will be conducted in the municipality of Lourinhã, located in the Oeste region. Due to its proximity to Lisbon and the metropolitan area, Lourinhã is significantly influenced both demographically and socioeconomically. The Oeste region is characterised by a combination of coastal and rural influences. Notably, horticulture, fruit farming, surfing, beaches, monumental heritage, and geology make tourism a key economic activity in the region.

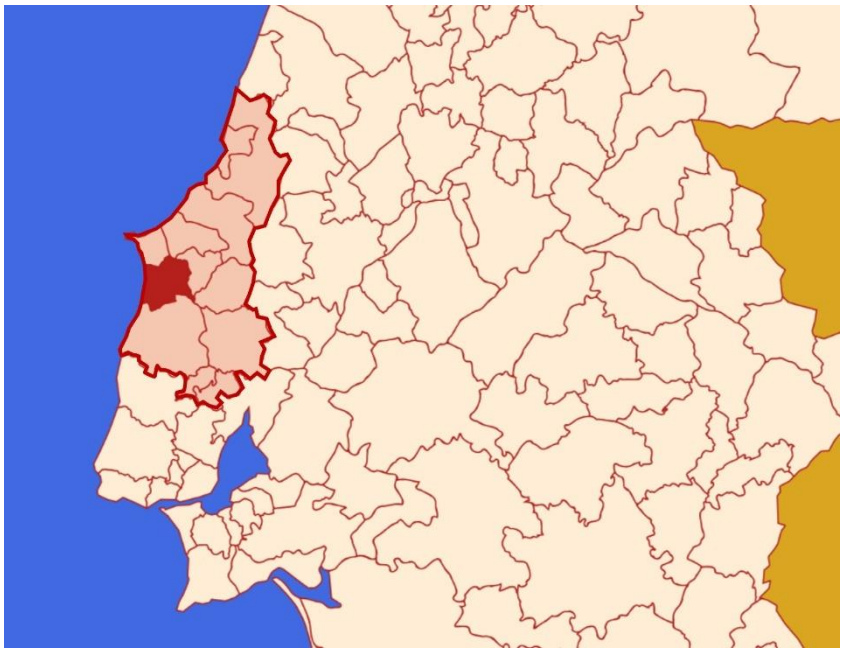


Figure 1. Location of Lourinhã Municipality (solid fill) located within the Oeste Region (dark red limit) in Portugal.

Lourinhã exhibits a geographical duality, with agricultural land covering 80% of its territory and a coastal strip extending approximately 12 km. The municipality's economy is primarily supported by agriculture and fishing, with small-scale commerce also playing a significant role. Other key economic activities include trade, livestock

farming, construction, forestry, and industry. Agriculture remains the dominant land use, with major crops including potatoes, Rocha pears, and vineyards.

In the Lourinhã region, two major water-consuming sectors stand out: irrigated agricultural zones and tourism facilities with golf courses.

The management of wastewater drainage services in Lourinhã is overseen by the Municipality, while water treatment is carried out by Águas Tejo Atlântico, S.A., through several Water Treatment Plants located in the region. The system comprises six Water Factories, approximately 276 km of sanitation pipelines, and multiple pumping stations.

Given the region's high demand of water for agriculture and tourism, the reuse of treated wastewater presents a viable and sustainable solution. The adoption of ApR could help mitigate water scarcity, support agricultural productivity, and promote environmentally responsible tourism development.

1.2. Spanish context

The case study in Spain will be carried out in the region of Badajoz, which is located in southwestern Spain and is part of the Guadiana River basin. Badajoz is an eminently rural region, with a population of 670.000 and a population density of around 30 inhabitants per km^2, well below the national average of 90 inhabitants per km^2. The main productive activity in the region is agriculture, with around 42% of the territory being occupied by farmlands. Cereals (mostly wheat, oats, corn, and rice) and olive trees are the main crops in the region, followed by vineyards and fruit trees.

Figure 2. Territory of the Guadiana River basin, marked in red. The region of Badajoz comprises the western half of the basin.

Many small municipalities in the Badajoz region lack the means and resources to oversee their own water management process. In order to ensure that proper service is delivered to all inhabitants in the region, the PROMEDIO consortium manages the purification and supply of water to these small rural villages, as well as the management of waste.

In Spain, the amount of effluent flow that can be allocated for reuse is heavily limited by the environmental flow of the river which the water treatment plant discharges to. The environmental flow of a river is defined by Law 11/2005 of June 22 of the National Hydrological Plan as the minimum water flow needed to sustain the river fauna as well as the riverbank flora. This is of particular importance in arid inland

regions such as southwestern Spain where most of the river flow comes from the effluent flow from the wastewater treatment plant, especially during the summer months. For this reason, according to the Guadiana Hydrographic Confederation, the maximum amount of effluent flow that can be reused on any given wastewater treatment plant must be calculated on a case-by-case basis, and depends on the availability of flow in the discharge point as well as the environmental flow of the river.

To add to this, Royal Decree 1085/2024, which regulates the quality requirements for reclaimed water, also points out that water reuse, while potentially very useful in coastal areas, might not be viable in inland regions precisely because of the aforementioned environmental flow issue. Because of this, this Royal Decree recommends that, at least in inland areas, reclaimed waters should be used mostly or even exclusively for urban applications such as washing streets.

The Guadiana Hydrographic Confederation (*Confederación Hidrográfica del Guadiana*, CGH) is the competent authority that sets the limits and specifications for water reuse in the Guadiana River basin. One of the limitations set by the CGH for the reuse of wastewater in this region is set in Article 33 of the Guadiana Hydrological Plan. According to this Article, concessions for the use of reused waters will be granted only to substitute similar concessions for the use of water from conventional sources; in other words, end users who wish to incorporate the use of reclaimed water to their productive processes must first give up an equivalent concession for the use of water from non-reused sources. This is done to prevent end users from having access to water from multiple sources, which could lead to a wasteful overuse of the available resources.

Regarding the context of the end users in the area, in the Guadiana River basin, particularly in the Badajoz region, most end users are made up of small farms which

are connected to the sanitary sewer network, where the only extraction point is at the exit point of the wastewater treatment plant and which is limited as explained previously by the environmental flow. The large producers and end users in the region are organised in communities of irrigators with direct access to great reservoirs; among these users, the interest in reclaimed waters is slim. There are irrigators located in areas far away from these resources who could be interested in using reclaimed waters, especially in areas with overexploitation of subterranean waters, but these irrigators are small farmers located in very specific areas of the Guadiana River basin. These farmers represent potential users of reclaimed waters in southwestern Spain, but delivering reused water to them remains a challenge.

Taking all of this information into account and considering the real context of the region, the main scenario for water reuse in southwestern Spain would revolve mainly around urban use, and the source of the water would be urban wastewater treatment plants.

1.3. French context

The SOLLAGUA case study territory for the development of water reuse in the Ariége is called the Couserans-Pyrénées. The "Communauté de Communes Couserans-Pyrénées" is an administrative territory in southern France which was established in 2017 and covers 94 villages and about 30.000 inhabitants. In this territory, the treatment of wastewater (both collective and non-collective), as well as the supply of water to inhabitants, is managed by Service des Eaux du Couserans, a SOLLAGUA consortium partner, and two other services. Service des Eaux du Couserans, which covers 78 villages and 28.000 inhabitants around St. Giron and Saint Liziers, covers the majority of the needs in the area. This Service is a public structure that supervises the water treatment plans of the villages and towns of Couserans with a large variety

of solutions ranging from full grey to full green solutions such as planted filters and lagoons. So far, water recycling has not been applied in any of these collective treatments, although several use cases are present, mostly for agricultural needs, but also for firefighting and cleaning purposes.

Figure 3. Location of the Couserans administrative limits in the Pyrenees, south of the Occitanie region in France.

Due to its location in southern France, this area frequently experiences water scarcity issues. In the event of a drought, irrigation is sometimes prohibited during certain periods, which greatly affects crops and puts farmers in a complicated position. The matter of water supply is therefore crucial, and solutions such as water reuse are emerging to alleviate these issues.

In Ariége, as in many rural regions in France, farmers typically live close to their farms, allowing easy access to their lands and livestock. However, there may also be farmers who live in villages or in small towns located near their farms. The exact location may vary depending on the type of agriculture practised and the infrastructure available.

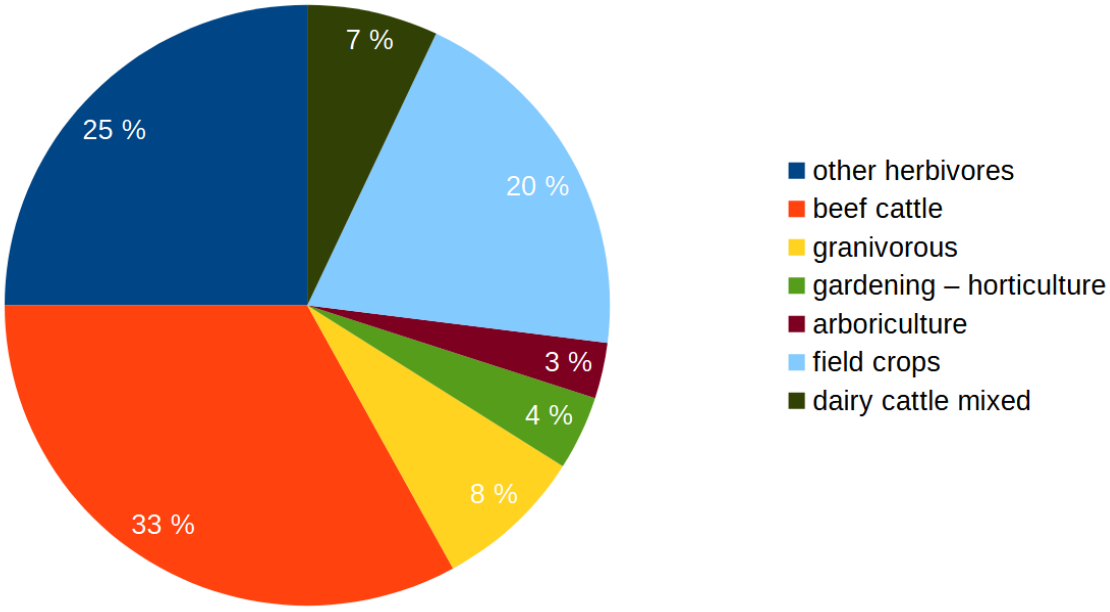


Figure 4. Types of agricultural practices in Ariége.

Given that farmers in Ariège live close to their farms, there is significant potential for the reuse of domestic water; indeed, the proximity to their crops would allow this water to be recovered for irrigation. In addition, these farmers could use the roofs of their homes to collect rainwater, providing a sustainable and local solution for meeting their water needs while reducing dependence on external resources.

A unique aspect in Ariège is the wave of "neorurals" in farms, a phenomenon that reflects a change in the lifestyles and aspirations of many people. Neorurals are city dwellers who choose to re-settle in the countryside attracted by a simpler lifestyle in harmony with nature, and often motivated by ecological and social values. Enhancing a novel vision of agriculture and considering themselves as "engaged", these neorurals introduced agriculture innovations like permaculture projects, organic farming or other sustainable practices. These new areas often bring a variety of skills, a new dynamic and a desire to revitalize rural territories, sometimes by taking over

existing farms or creating new initiatives. Neorurals thus contribute to diversifying agriculture in Ariège, by introducing innovative practices and strengthening links between producers and consumers. Introducing the reuse of water from wastewater treatment plants in the Couserans reflects the desire of farmers in this small region to move towards a more ecological form of agriculture, and to limit the extraction of water from its natural environment (preserving water tables, etc.).

In short, the growing presence of neorurals in Ariège farms is a sign of rural renewal, where agriculture reinvents itself and adapts to contemporary issues while preserving the natural and cultural heritage of the region. The rural LL of "Demain La vallée"[1] is typical of this brainstorming between scientists and farmers, which leads to innovative practices in Ariége.

The typology of agricultural production in Ariège is very diverse. Beef, dairy products and cereals are the top products in Ariège. Market gardening is now in full development and short-circuit sales are one of the new phenomena that allow it to flourish. There are many agricultural enterprises for food and non-food productions, from small to large surface area of exploitation. Non-food production revolves mainly around horticulture for plants and trees. Food production is characterised by a large development of cattle, goats, lambs and poultry. Vegetables and fruits are also present (20%), from small gardens to large field crops or orchards (Figure 4).

Many farmers are over 50 years old, but the number of farms has been growing in recent years. Between 2015 and 2020,294 new farmers were established, of which 37% were women.

[1] https://www.youtube.com/watch?v=H8bHgQ3-5K4

2. Evaluation of stakeholder needs through Living Labs workshops

As part of the SOLLAGUA project, Living Labs workshops were carried out in Portugal, Spain and France throughout 2024. Stakeholders were invited to attend and given a brief presentation on both the SOLLAGUA project as well as the concept of Living Labs. Afterwards, stakeholders were given the opportunity to share their needs and what they believe are the most pressing issues and barriers to adoption to the use of reclaimed waters in their region. The next section will analyse the feedback that was gathered during these Living Labs workshops by focusing on the needs for water. This approach in the SOLLAGUA project fits within the first deliverable of the Water Oriented Living Labs series of tasks, in agreement with the overall strategy of "fit for purpose" for the reuse of water. Information about barriers was also collected during these workshops; this data will be gathered and analysed in deliverable 3.1, centred on identification of barriers and limits to green solutions for reuse in rural areas.

2.1. Portugal

The first Living Lab was held in Lourinhã, Portugal the 22nd of May, 2024. After a presentation on the SOLLAGUA project and an introduction to the concept of Living Labs, the stakeholders were questioned on a series of topics in a roundtable format. 18 stakeholders participated in the event. These stakeholders came from municipalities, research institutions, public water supply services, farmers' associations, and environmental associations. The distribution of participating stakeholders can be seen in Figure 5:

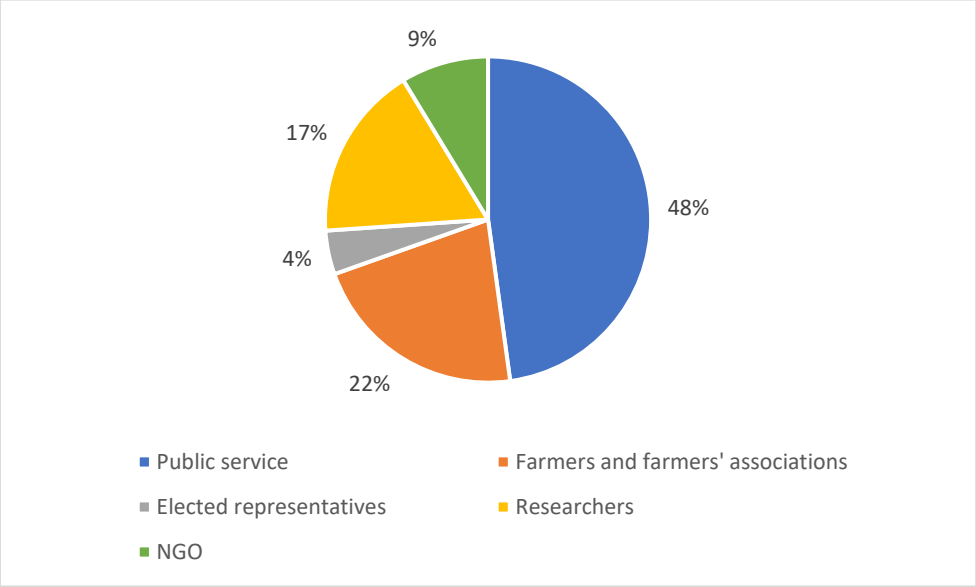


Figure 5. Distribution of participating stakeholders in the Portuguese Living Lab workshop.

Figure 6. Picture of the Living Labs event held in Portugal as part of the SOLLAGUA project.

The first of these topics was the effect of water scarcity and climate change affecting rural communities. Stakeholders agreed that water scarcity will continue to be a problem in the long term due to continuous changes in rainfall patterns, with out-of-season precipitation and periods of drought coinciding with the greatest need for water. Participants also agreed that water scarcity will impact all sectors of productivity. It was also pointed out that there is an issue not so much of scarcity but of unequal distribution in relation to the temporality of demand; that is, there is more rainwater than what is used in Portugal, but this water comes from short, more intense rainfalls which are not considered beneficial.

Following this, the participating stakeholders were asked to identify the challenges that they currently face, and they agreed on the following:

- There is a growing need to find solutions to make the most of the available water. It is essential to choose crops that require less water.
- The issue with the lack of water storages is exacerbated by the irregularity and increasing intensity of rainfalls. This irregularity results in unpredictability, which is yet another challenge that must be tackled.
- The need for sustainable, multi-purpose management of water is urgent.
- Rising costs, coupled with the lack of strategic funding programs, are a challenge.
- There is a need for cooperation between municipalities and governmental organizations.
- Dependence on the State makes finding solutions difficult.

Afterwards, the stakeholders were asked which measures they considered to be viable in tackling these challenges. Several potential solutions were put forward:

- The possibility of increasing the adoption of **adapted crops**, alterations to the use of soil, and modifications to agricultural practices to minimize water run-off was presented. However, it was pointed out that the sustainable production of crops makes competing with international products, which don't follow those standards and thus are sold at lower prices, makes this difficult.
- The **transfer of water** from regions where it is abundant to regions in need was suggested. However, there are concerns about the negative consequences for biodiversity, conflicts of use and elevated costs. While this is not considered an effective solution at the moment, it deserves consideration.
- It is imperative to influence **change in European policy** through the state government. Water policy must be a priority in the political agenda.
- It is important to **reduce water runoff** and promote the **storage of surplus water** from intense rainfall events through the creation of multiple lower-capacity storage points and action plans for the recharge of aquifers. This would, in turn, prevent the excessive loss of water to the sea. This storage, of course, must be done in a sustainable way.
- The **reuse of treated wastewaters** was introduced as a possible solution to water scarcity.
- The **creation of a water observatory** to monitor parameters such as available volume of water, consumed volume, amount of rainfall, and other relevant data. Knowing these parameters is essential to determine whether there is a shortage of water, as in some areas, the volume of water used in agriculture every year is unknown.

As a summary of the event as a whole, it can be said that the stakeholders arrived at the following conclusions:

- A sustainable, multi-source management of water is needed.

- Communication on the safety of reclaimed waters must be improved. To achieve that, a study on the quality of reclaimed waters must be conducted.
- A streamlining of the bureaucratic process for requesting and authorizing the use of reclaimed waters for agriculture must be achieved.
- There must be a network between the production and use of reclaimed water.
- Cooperation between municipalities, public services and end users is essential.

2.2. Spain

The second Living Lab of the SOLLAGUA project took place in Badajoz, Spain the 18th of September, 2024. During this event, the guest stakeholders were given a brief presentation on the SOLLAGUA project and asked a series of questions regarding the needs and barriers to the widespread use of reclaimed waters. The 29 participating stakeholders were distributed as seen in Figure 7:

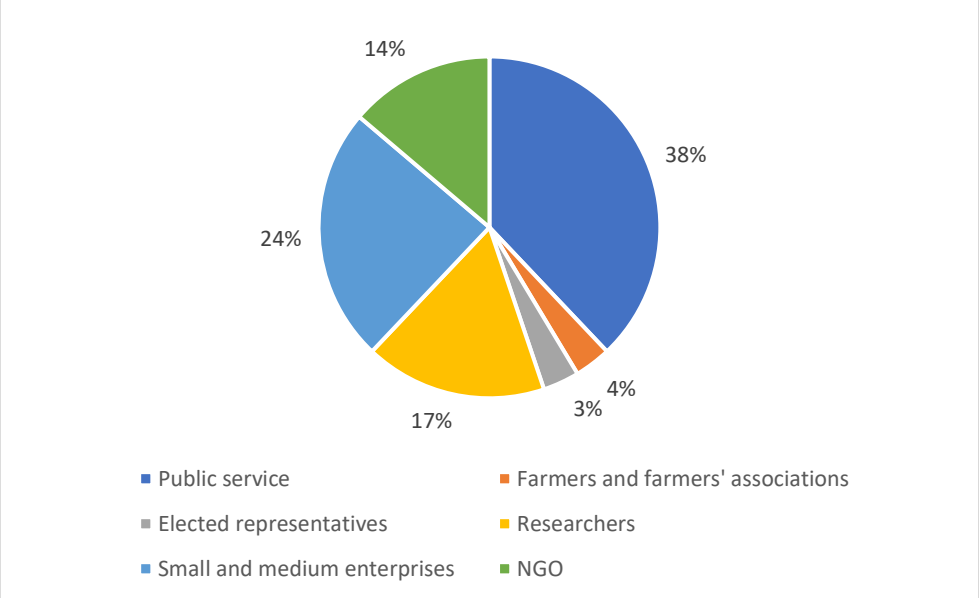


Figure 7. Distribution of participating stakeholders in the Spanish Living Lab workshop.

Figure 8. Picture of the participating stakeholders in the Living Lab held in Badajoz, Spain.

As for the reported needs, the competent authorities (elected representatives) pointed out the need to incentivise the use of reclaimed waters in agriculture through licences, as well as the need to carry out studies that clearly define a cost-benefit analysis of the use of reclaimed waters compared to water from conventional sources. As for the barriers, the competent authorities pointed to the lack of streamlining in the administrative procedures involved in submitting applications for concessions as the main one.

Private users (small and medium enterprises) brought up the need to use reclaimed waters for cleaning purposes in the very same WWTPs where they are treated, as well as the need to create a clear network between the production and utilization of said waters. They also emphasised the need to incentivise the use of reclaimed waters in industry, perhaps through the creation of grants for small and medium-sized businesses.

Public service members mentioned the need to take full advantage of reclaimed waters for agriculture and animal feed, though they claimed not to be sure how to achieve this safely. They also emphasised the need to make sure that the use of reclaimed waters does not result in increased costs for the end user.

User organizations (farmers and farmers' associations, NGOs) brought up sustainable urban drainage systems, citing them as a possible source of reclaimed waters. They indicated that in coastal areas, where there are many residential areas located far from the city centres, the use of reclaimed waters for toilet flushing and other low-impact uses should be incentivised.

Lastly, researchers pointed out the need to increase the knowledge on water mass quality with the goal of incentivising the use of reclaimed waters for the betterment of ecosystems. The possibility of using data analysis techniques or artificial intelligence to improve the technology used in the generation of reclaimed waters was also brought up by these stakeholders.

2.3. France

The third and final Living Lab took place in Saint-Girons, France the 15th of November, 2024. As with the previous two Living Labs, the participating stakeholders were given a presentation on the SOLLAGUA project before being asked on their needs as well as the barriers to water reuse. 26 stakeholders took part in the event. These stakeholders were classified in the following categories as shown in Figure 9:

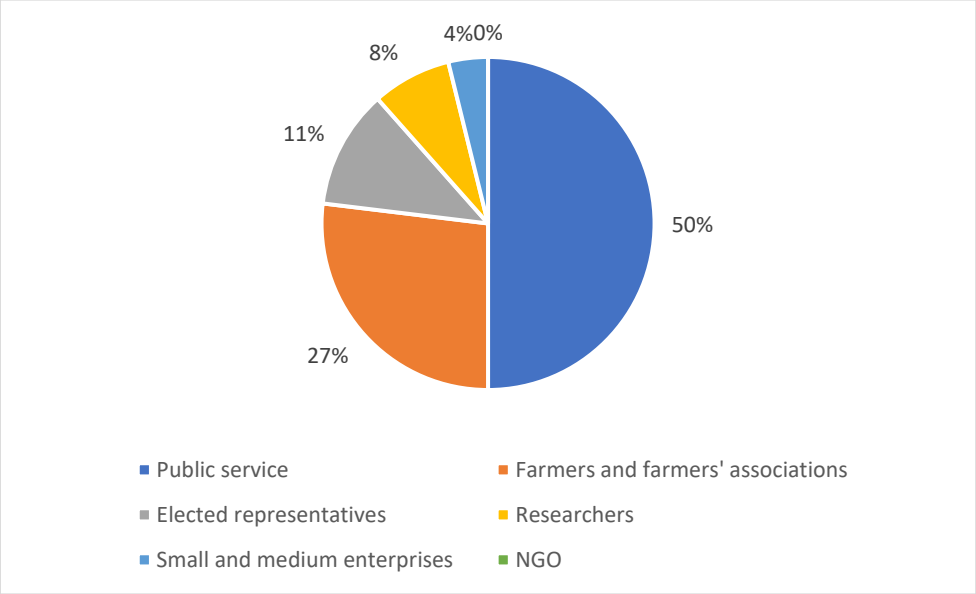


Figure 9. Distribution of participating stakeholders in the French Living Lab workshop.

Figure 10. Roundtable discussion between stakeholders during the Living Labs event in Saint-Girons, France.

During this event, stakeholders were posed questions about their needs and expectations regarding non-conventional sources of water such as reused rainwater or domestic water. The answers were grouped in 5 categories, and the answers were

counted to identify the major concerns. 43% of stakeholders identified practical needs as their main focus regarding the use of non-conventional sources of water; 21% of stakeholders pointed to regulatory needs; 21% pointed to technical and economic needs; 13% of stakeholders were concerned about contextual and environmental needs; and lastly, 2% were interested in social needs.

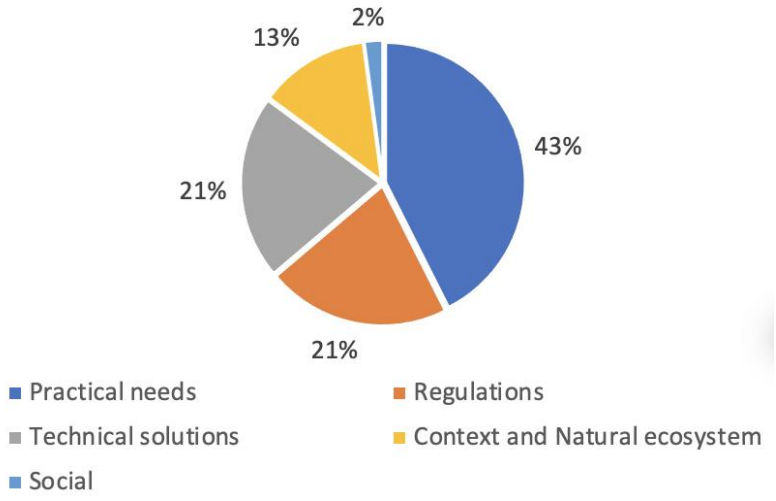


Figure 11. Distribution of stakeholder needs according to Living Labs feedback.

- Practical needs:
    - Drinking water must not be used for domestic use such as toilets and washing machines.
    - Municipalities should use reclaimed waters to water stadiums, green spaces, hedges and trees.
    - Reclaimed waters should be used as drinking water for livestock.
    - Reclaimed waters can be used for industrial purposes such as washing or cooling.
    - Reclaimed waters can be used by fire brigades and in small networks.
- Regulatory needs:
    - Need to determine who is responsible for water quality.
    - Need to determine a water quality for each use.

  - Whether there is a need to provide information about the use of reclaimed waters.
  - Need to encourage the use of reclaimed waters when applying for construction permits.
- Technical and economic needs:
  - Need to ensure the security of the water supply in general.
  - Need for on-site technical support for reflection (on reuse and consumption of water) and implementation.
  - Need for consideration of tributary streams.
- Contextual and environmental needs:
  - In the case of intermittent watercourses, reusing water can lessen the environmental impact during low-water periods.
  - Need to preserve the environment.
  - Need to ensure that water sources are not polluted.
  - Need to ensure a good quality and quantity of water for aquatic environments, maintaining a temperature of around 24ºC.
- Social needs:
  - Need to remove psychological barriers to the use of reclaimed waters.

As a summary of the Couseran framework regarding water provisioning, there are three major types of organisations where water recycling could be explored to ensure the sustainability of the territory activities towards water demands:

1. From an existing WWTP under supervision of the local authority that is the Service des Eaux du Couserans, with a need to identify possible uses of reclaimed water in the surrounding area. French policies are not restrictive regarding the quantity of water that can be reused in this type of organisation, but regulation is very strict about the quality of the water for reuse.

2. From a village or hamlet not yet connected to the collective wastewater network and which would require the creation of a new WWTP and identification of possible uses in the vicinity. This is an interesting possibility because it allows for the design of a relevant project that would solve a problem of wastewater management from the public. However, it would take more time and budget and would not necessarily fit within the SOLLAGUA framework.
3. From a local group of houses or farms with more than 20 inhabitants with the need to identify possible uses in the vicinity. This way could allow projects to be implemented more quickly, but may fall outside of the scope of the public authority and fit in civil society organisations (or rather unorganised citizens) for the promotion of reclaimed water.

3. Stakeholder survey results

In order to better understand the practical needs of the stakeholders in the three countries, online surveys were conducted after the Living Labs event. These were intended to be as similar as possible between the countries, and covered topics regarding the needs for reclaimed waters, Nature-Based solutions, and other related issues. In total, 21 respondents participated in the Portuguese survey, 11 in the Spanish survey, and 12 in the French survey. These respondents were stakeholders involved. These surveys were posted online on the SOLLAGUA website and shared individually with stakeholders, and were intended to cover similar topics across all three countries. In total, 21 respondents participated in the Portuguese survey, 11 in the Spanish survey, and 31 in the French survey. In this chapter, we will present the questions from each category as well as a brief discussion on the responses obtained. These respondents were stakeholders involved in different levels of the water management cycle such as public service officials, elected representatives, and farmers, among others.

3.1. Portugal Living Lab Survey results

The survey shared among Portuguese stakeholders included 21 questions divided in 6 topics:

- General stakeholder questions
- Origin and use of reclaimed water
- Quality parameters
- Nature-Based Solutions for water reuse
- Accessibility

- Perception of cost

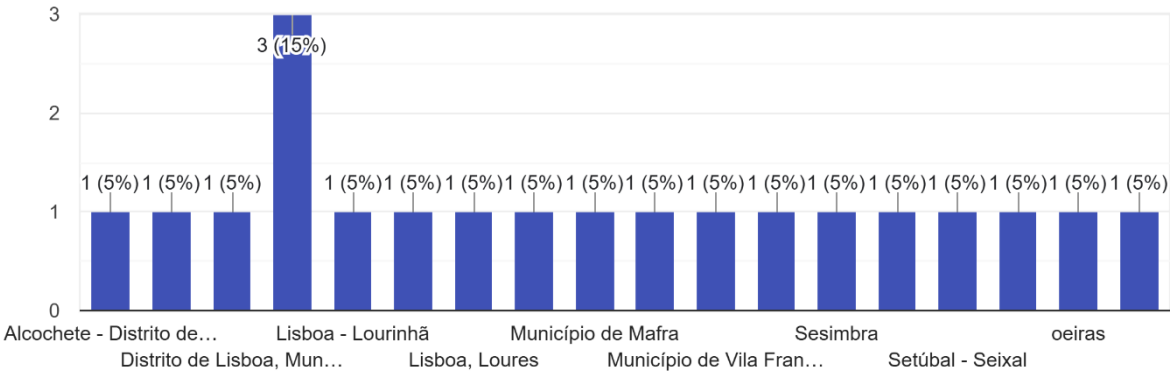
In total, 21 respondents participated in the survey. We will present the questions asked in each block and analyse the responses given by the stakeholders.

3.1.1. General stakeholder questions

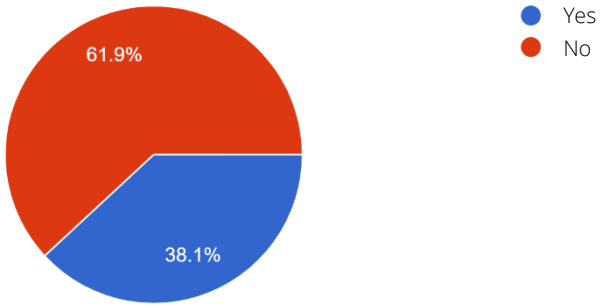
Question 1. Which sector related to water reuse do you represent?

Most respondents, 52.4%, belonged to a public administration, whereas another large group representing 23.8% of respondents belonged to water management and sanitation entities. The remaining respondents were distributed among farmers, researchers, non-governmental organizations (NGO), and consulting firms.

Question 2. In which district and municipality/municipalities do you carry out your activity?

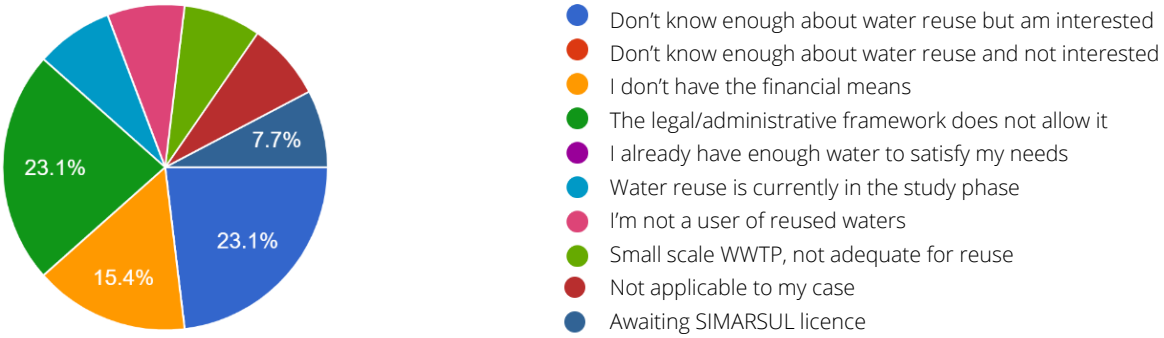


Question 3. Do you currently have a water reuse project?



Though most respondents did not have a water reuse project at the time of the survey, a significant portion (almost 40%) stated that they did.

Question 3.1. If you answered no to the previous question, why?



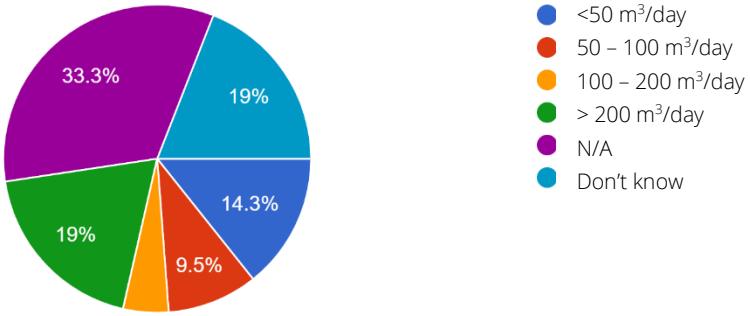
Reasons for why respondents did not have a water reuse project at the time of the survey were diverse. Many stakeholders do not have a deep knowledge of water reuse but are interested in learning more, while others pointed out the existing administrative and legal barriers to implementing a water reuse project. Others still claim to lack the financial means to implement such a project.

Question 4. Which of these potential uses for reclaimed water do you consider to be most relevant?

33.3% of respondents agreed that urban use is the most relevant, while 28.6% opted for agricultural use, and 19% chose industrial use. Other users were considered much less significant by stakeholders. In summary, we can consider urban, agricultural and industrial use to be the most important uses for reclaimed water according to Portuguese stakeholders.

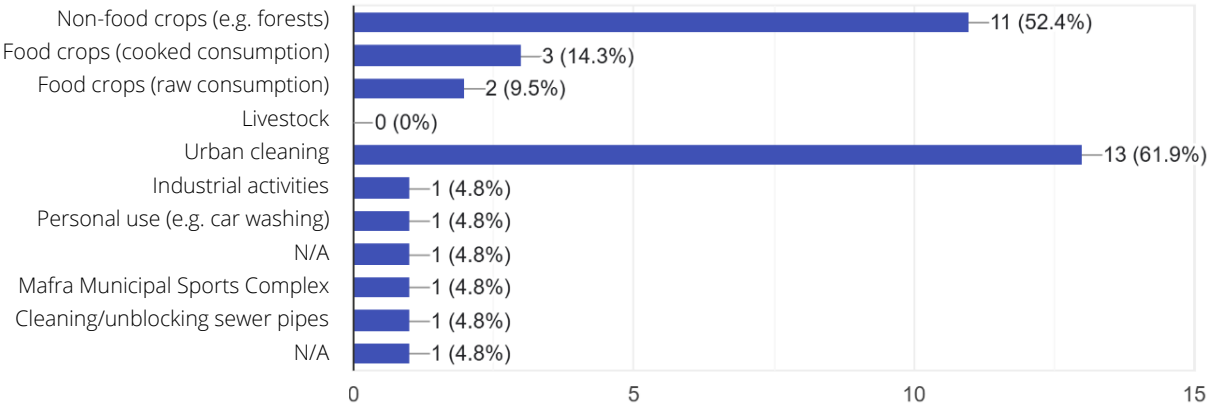
3.1.2. Origin and use of reclaimed water

Question 5. What amount of water for reuse would you consider using in your productive process?



Of those stakeholders who chose to give a concrete number, 19% chose over 200 m^3/day, 14.3% chose under 50 m^3/day, and 9.5% chose between 50 and 100 m^3/day. This data shows that needs are highly individualised and vary depending on the stakeholder.

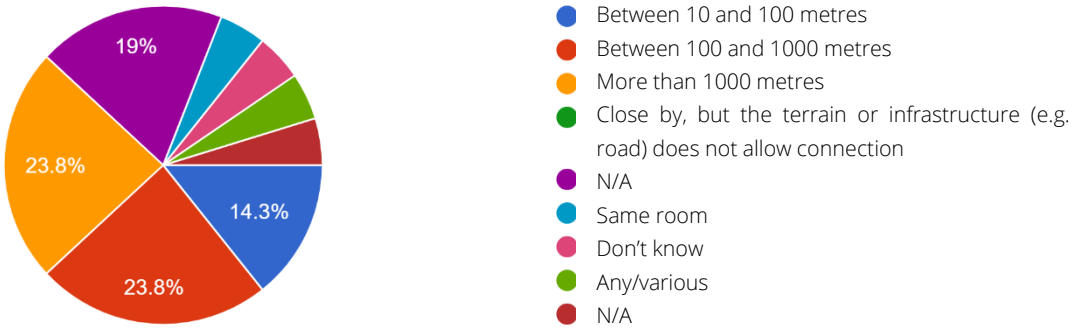
Question 6. What would you use the recycled water for?



Two uses for recycled water stand out about the rest, those being urban cleaning and irrigation of non-food crops. This is consistent with the responses to Question 4,

where agriculture and urban use were chosen by the stakeholders as the most relevant potential uses for reclaimed water in Portugal.

Question 7. What is the distance between the source and location where the reused water would be used?

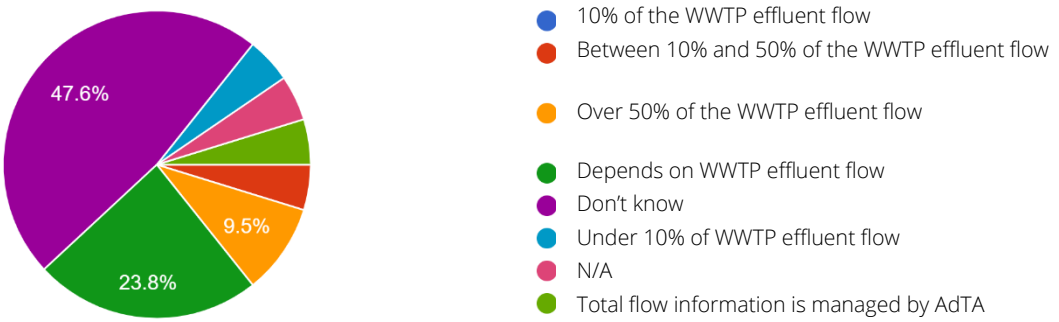


Answers were varied again, but distances over 100 metres were frequent, pointing to a need for pumping systems rather than use in situ.

3.1.3. Quality parameters

These questions address general aspects about quality parameters of reclaimed waters and the stakeholders' familiarity with the laws that regulate these quality parameters in Portugal.

Question 8. How much effluent water from a wastewater treatment plant (WWTP) is available for reuse?



The aim of this question is to gauge the stakeholders' familiarity with the existing Portuguese legislation regarding the amount of effluent flow from wastewater treatment plants that is allowed to be reused. Almost half of respondents didn't know the answer to this question, while 23.8% claimed that it depends on the WWTP effluent flow and 9.5% stated that over 50% of the WWTP effluent flow can be reused. Portugal does not establish a limit to the amount of effluent flow that can be reused.

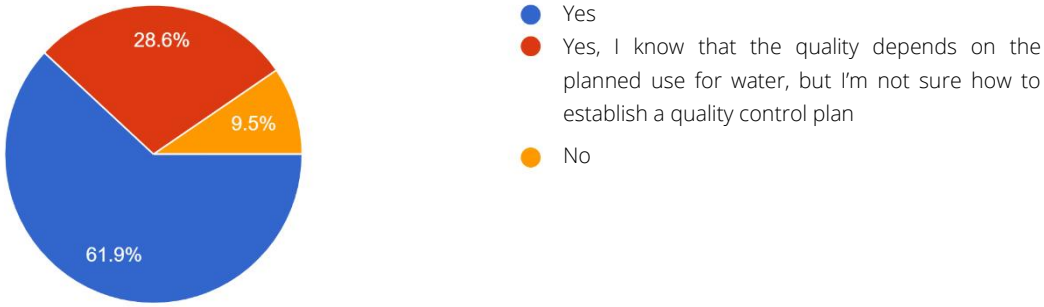
Question 9. Regardless of existing regulations, do you believe that quality requirements could be adjusted depending on intended use? E.g. reducing nutrient requirements to enhance the fertilization capabilities of reclaimed water.

Most respondents, about 57%, agreed that quality requirements for reclaimed waters could be adjusted depending on the end use, but that a risk analysis assessment and a containment plan for those risks should be required. Overall, very few stakeholders disagreed with adapting quality requirements to the intended use.

Question 10. Are you aware of the legal regime for the production of water for reuse, obtained from treated wastewater, as well as its use, established by Decree-Law No. 119/2019?

The majority of respondents claimed to be aware of Decree-Law No. 119/2019, which regulates the quality requirements for reclaimed waters in Portugal. Still, a sizeable amount, 33.3%, claimed to only have some familiarity with the topic.

Question 11. Are you aware of the obligations regarding the quality control of reclaimed waters?



Once again, most stakeholders are familiar with the obligations regarding the quality control of reclaimed water, though a significant fraction of stakeholders (28.6%) said that they do not know how to establish a quality control plan.

Question 12. Do you know the administrative process needed to authorise the use of reclaimed waters?

Only 38.1% of respondents were fully aware of the necessary procedure to authorise the use of reclaimed waters.

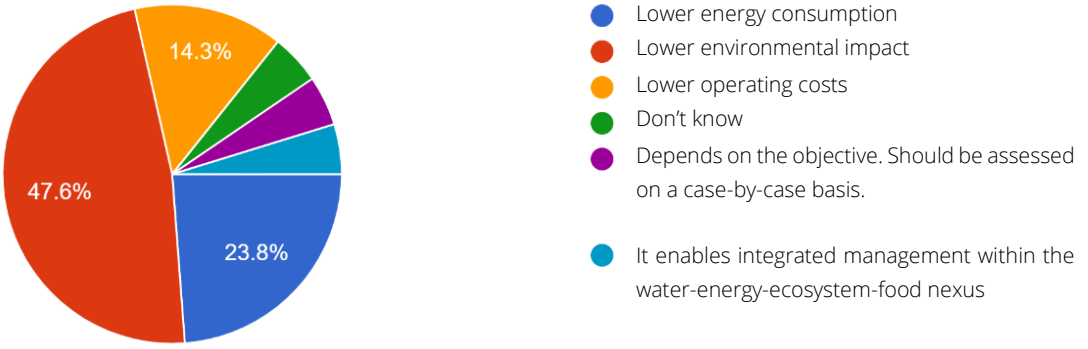
3.1.4. Nature-Based Solutions for water reuse

This question block relates to Nature-Based Solutions and aims to gauge the stakeholders' familiarity with the concept.

Question 13. Do you have any knowledge about the application of Nature Based Solutions (NBS) for wastewater treatment?

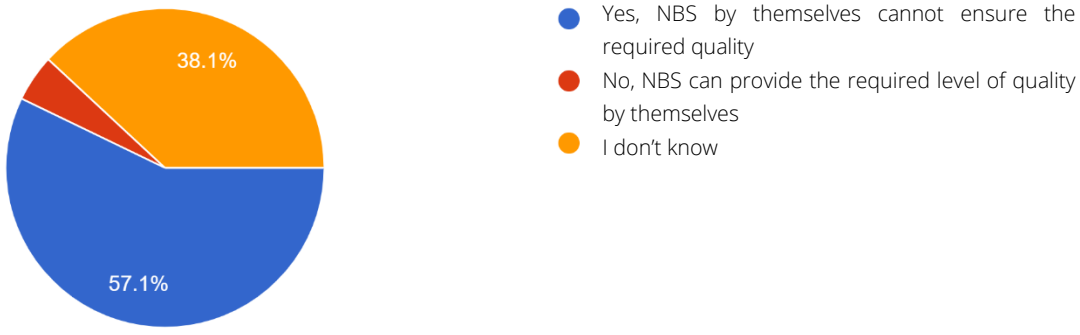
Most stakeholders have some familiarity with Nature-Based Solutions, but a sizeable amount, 33.3%, claimed not to have any knowledge on the subject.

Question 14. Which do you believe to be the best attribute of Nature-Based Solutions as a technology to reuse water?



Out of the potential benefits of Nature-Based Solutions, the most agreed upon was the lessened impact on the environment in comparison to more traditional technologies.

Question 15. Do you believe that it is appropriate to combine Nature-Based Solutions with other technologies at this point?



Most stakeholders agreed that NBS should be complemented with other technologies in order to reach the necessary level of quality.

3.1.5. Accessibility

These are questions related to the capability of stakeholders to implement Nature-Based Solutions in their installations and include reclaimed waters in their productive processes.

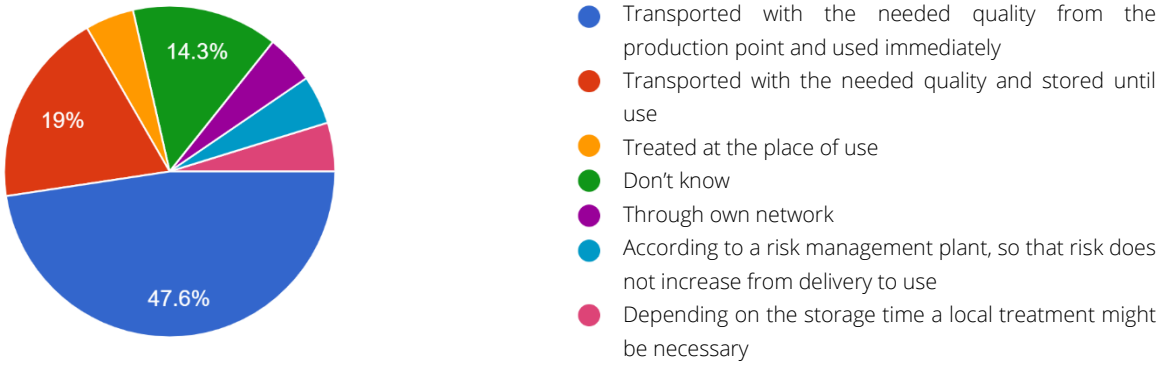
Question 16. Do you have space or terrain available to introduce a Nature-Based Solution?

The majority of stakeholders do not have the space or terrain needed to introduce a Nature-Based Solution in their installations.

Question 17. Do you have space or terrain available to store reused water before its use in your installation, as well as elements for water storage?

38.1% of respondents do not have space to store reused water in their installations, while another 38.1% have space but not the reservoirs needed for storage.

Question 18. How should access to reclaimed waters be managed?

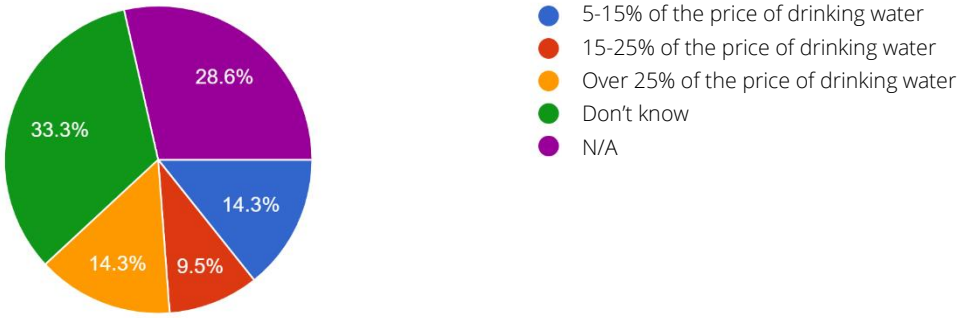


Almost half of respondents agreed that the reused water should be transported with the needed quality from the production point and then used immediately. Another 19% of respondents pointed to the possibility of storing the water until its reuse.

3.1.6. Perception of cost

Lastly, this set of questions addresses the stakeholders' opinions on what the price of reused waters should be and who should bear the cost of production.

Question 19. How much would you be willing to pay for reclaimed waters?

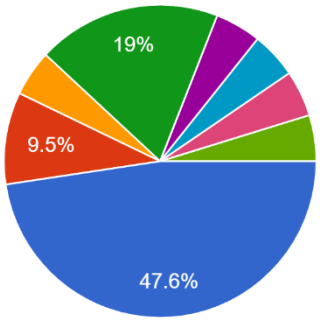


Opinions were divided among respondents who chose to answer this question, with answers fairly evenly divided between 5-15%, 15-25%, or over 25% of the price of drinking water, pointing to a lack of consensus among stakeholders regarding what the price of reclaimed waters should be.

Question 20. What is your estimation of the additional cost associated with the treatment of wastewater to make it suitable for reuse?

From the responses to this question, it can be concluded that there is a lack of awareness among stakeholders on the cost of production of reclaimed waters.

Question 21. In your opinion, who should bear the additional cost to achieve the needed quality for reuse?



- The end user
- The entity that manages the treatment plant
- The public administration (e.g. câmara municipal)
- The central administration (e.g. government)
- Don't know
- The cost should be lower, not higher
- Depends on the purpose
- Shared between the managing entity, the city council and the user

Almost 50% of respondents agreed that the end user should be responsible for bearing the additional cost.

3.2. Spain Living Lab Survey results

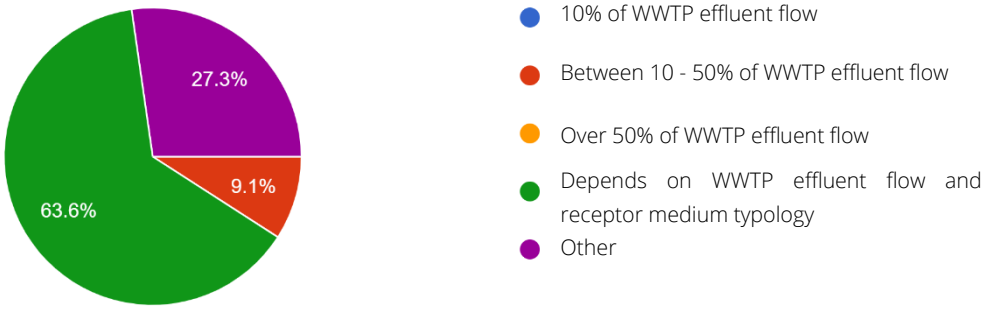
The survey shared among Spanish stakeholders included sixteen questions divided in seven topics:

- Available volume
- Needed volume
- Quality requirements
- Quality needs
- Accessibility
- Nature-Based Solutions
- Price/perception

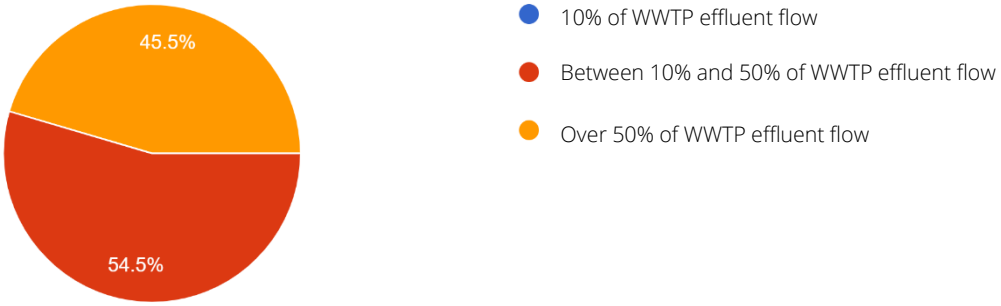
3.2.1. Available volume

The first set of questions pertained to the available volume effluent flow of water to be reused from Wastewater Treatment Plants (WWTPs) for the purpose of reutilization.

Question 1. What is the amount or volume of water available to be reused per the regulation? (Competent authorities)



Question 2. Which volume of water do you believe is appropriate to be reused from the effluent flow of the facility you manage? (Operators)

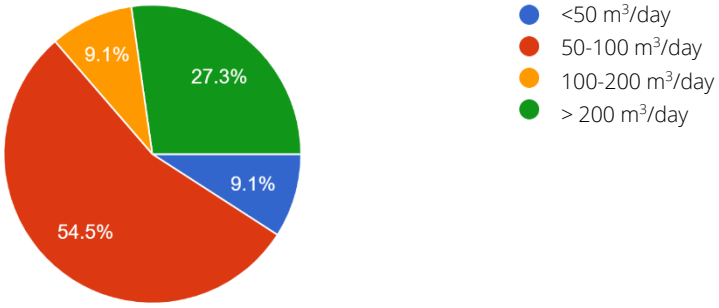


In this case, around half of respondents agreed on reusing between 10% and 50% of effluent flow, while the other half agreed on reusing over 50% of effluent flow. No respondents chose the option to reuse only 10% of effluent flow, which indicates an interest to reuse high quantities of effluent flow.

3.2.2. Needed volume

The following question pertains to the specific amount of reused water that stakeholders plan to use in their productive processes. This question is of particular interest, as it identifies a specific need.

Question 3. How much reused water would you consider using in your productive process, knowing that the origin is wastewater from municipalities of 5.000 inhabitants or less? (Users and operators)

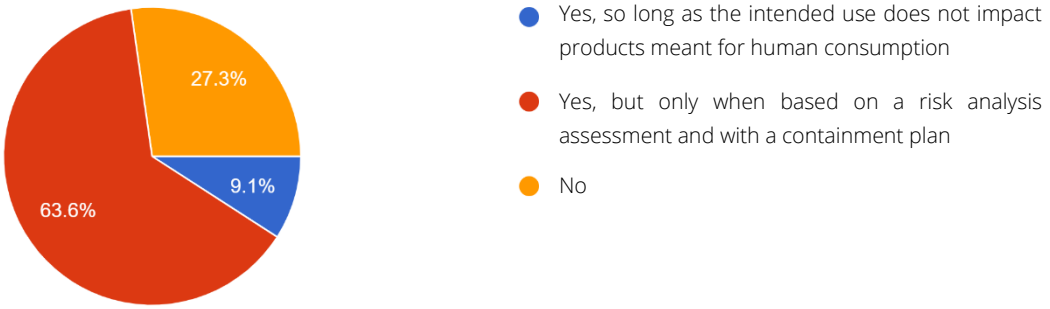


Over 50% of respondents agreed on the 50-100 cubic metres per day figure, with a little over 25% needing 200 cubic metres per day or more. These figures provide a tangible point of reference for stakeholder needs in Spain.

3.2.3. Quality requirements

The topic of quality requirements is the most extensive topic in the survey, and focuses on the stakeholders' familiarity with the Spanish law on quality requirements for reused waters and the administrative processes required to apply for an authorisation to use reclaimed waters.

Question 4. Regardless of existing regulations, do you believe that quality requirements could be adjusted depending on intended use? E.g. reducing nutrient requirements to enhance the fertilization capabilities of reclaimed water. (Competent authorities)



Here, 63.6% of respondents agreed with the notion of adapting quality requirements to the intended use of water, though they also believe that such adjustments must be accompanied by an assessment of the risks and a plan to address those risks should they arise.

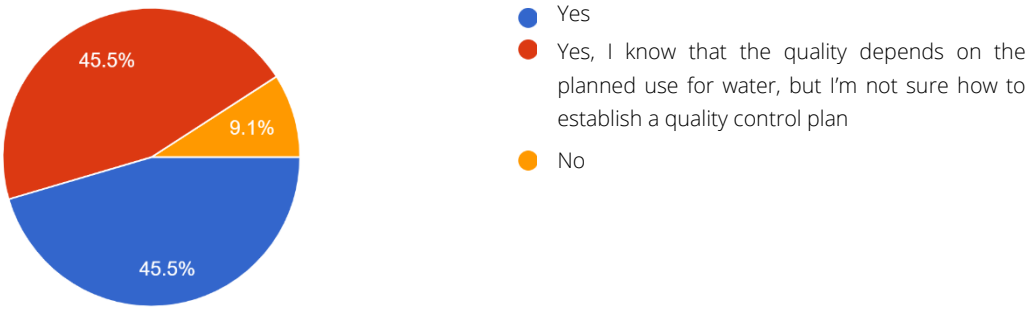
3.2.4. Quality needs

Question 5. Do you know the necessary quality requirements for reclaimed water according to its intended use? (Users and operators)

63.6% expressed some level of knowledge with the relevant legislation, while 36.4% purport to have extensive knowledge of the law. Overall, while no respondents

claimed to have no knowledge, we believe from these results that there is a widespread lack of knowledge on the prevailing laws. Note that, at the time of the survey, Royal Decree 1620/2007 was the law that was in force; the law has as of October 2024 been updated with Royal Decree 1085/2024.

Question 6. Are you aware of the obligations regarding the quality control of reclaimed waters? (Users and operators)



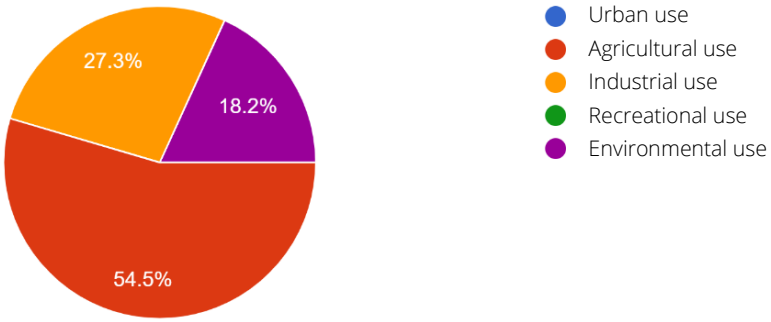
Once again, a high percentage of respondents either do not know of the obligation to monitor water quality (9.6%) or do not know how to perform said monitoring tasks. This points, again, to a lack of familiarity with the current legislation.

Question 7. Do you know the administrative process needed to authorise the use of reclaimed water? (All stakeholders)

Overall, about 73% of respondents either do not know of the mentioned administrative process at all, or they are aware of its existence but are not familiar with it. Only about 27% of respondents seem to both know about the procedure and

have familiarity with it. In other words, it can be said that, broadly speaking, stakeholders do not know how to obtain the necessary authorization to use reclaimed waters.

Question 8. Which of these potential uses for reclaimed water do you consider to be most relevant? (All stakeholders)

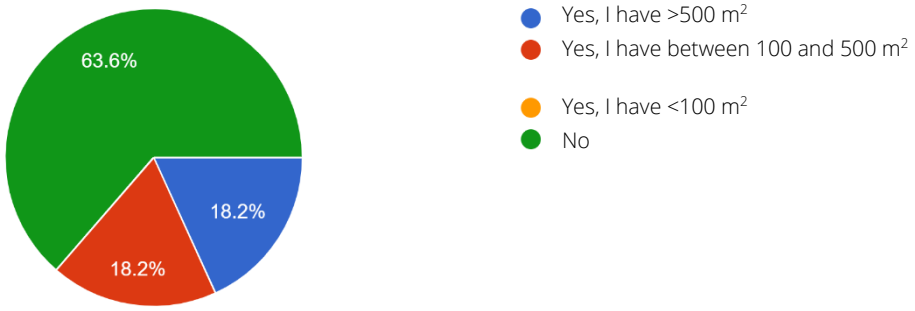


The majority of respondents, 54.5%, point to the agricultural use as the most relevant potential use for reclaimed waters. This is to be expected, as the participating stakeholders come overwhelmingly from rural areas. Still, industrial use makes up a 27.3% of responses, and environmental uses, at 18.2% of responses, also seem to be considered important by stakeholders.

3.2.5. Accessibility

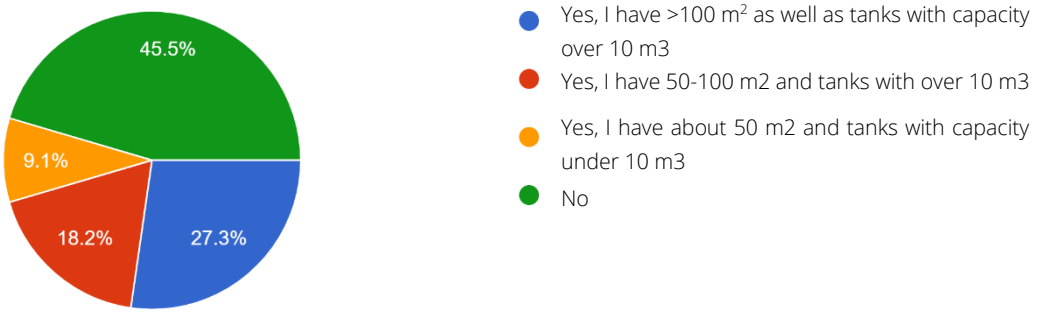
This topic focuses on the stakeholders' accessibility to Nature-Based Solutions and reclaimed waters.

Question 9. Do you have space or terrain available to introduce a Nature-Based Solution in your drinking water treatment plant? (Operators)



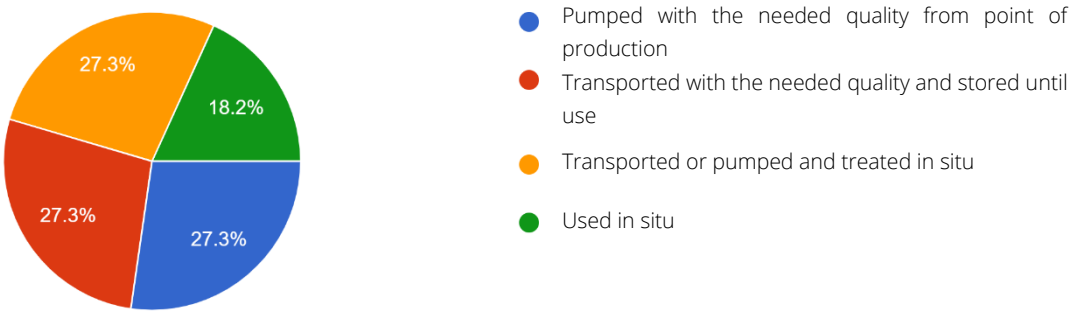
63.6% of respondents report not having enough space in their installations to introduce a Nature-Based Solution.

Question 10. Do you have space or terrain available to store reused water before its use in your installation, as well as elements for water storage? (Operators)



Similarly to the previous question, a high percentage of respondents do not have enough space in their installations to store reused water, although the number of stakeholders who cannot store these waters is lower than the number of stakeholders who cannot introduce a Nature-Based Solution in their installations. It seems clear, then, that more space is a pressing need for the stakeholders.

Question 11. How should access to reclaimed waters be managed? (All stakeholders)

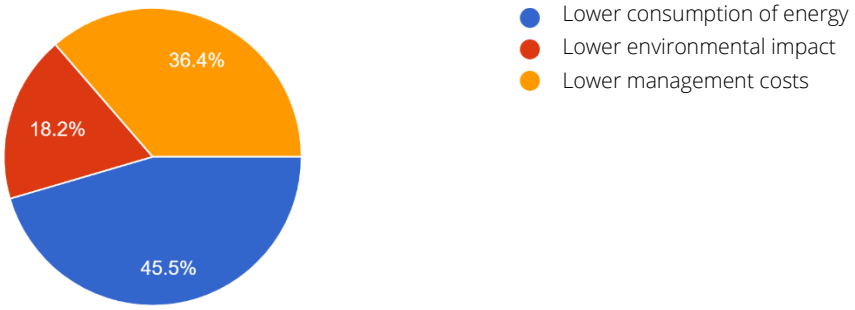


Responses were very dissimilar in this case, though it is clear that stakeholders overwhelmingly prefer these waters to be transported or pumped, rather than used in situ.

3.2.6. Nature-Based Solutions

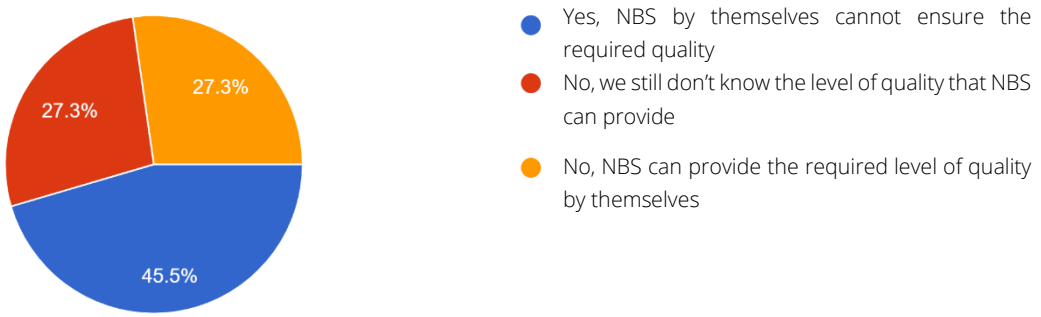
The questions in this category pertain to Nature-Based Solutions and the stakeholders' perceptions of their capabilities to produce safe, affordable water.

Question 12. Which do you believe to be the best attribute of Nature-Based Solutions as a technology to reuse water? (All stakeholders)



The main focus of the stakeholders seems to be on lower consumption of energy, as well as lowered management costs.

Question 13. Do you believe that it is appropriate to combine Nature-Based Solutions with other technologies at this point? (Users and research entities)

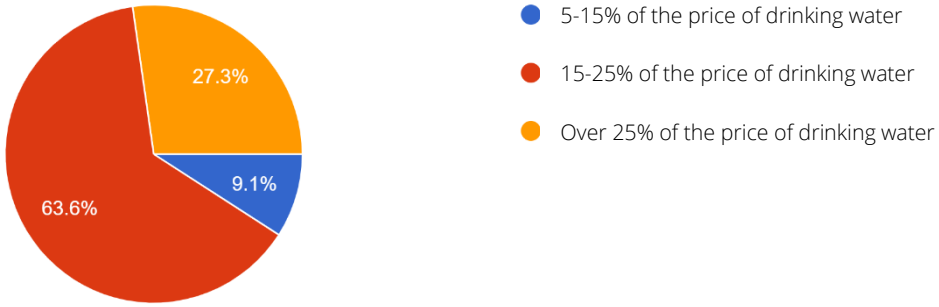


Stakeholder opinions seem to be almost evenly split, with roughly half of respondents considering that the combination of Nature-Based Solutions with other technologies is appropriate because Nature-Based Solutions alone are not enough to ensure the correct quality parameters, and the other half considering that these combinations are not appropriate.

3.2.7. Price/perception

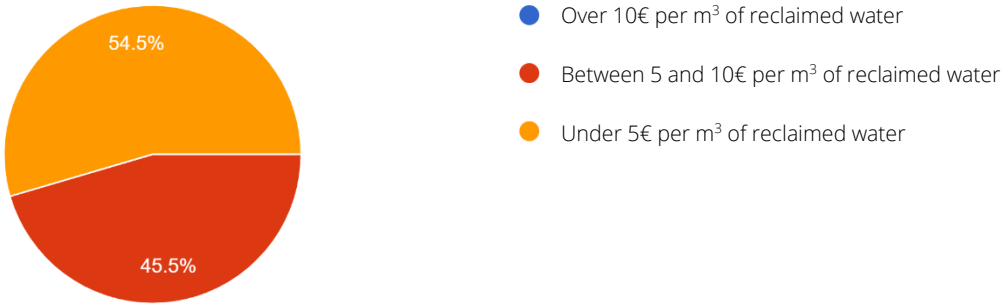
The final few questions focused on the stakeholders' perception of the price of reclaimed waters, how much they would be willing to pay for them, and who should bear the cost of use of these waters.

Question 14. How much would you be willing to pay for reused water? (All stakeholders)



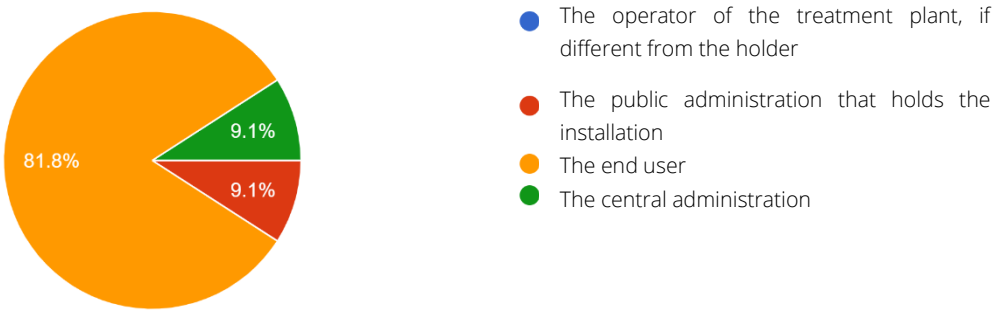
63.6% of respondents believe that the price of reused water should be lower than 25% of the price drinking water, with only 27.3% of respondents being willing to pay over 25% the price of drinking water. 9.1% of respondents chose an even lower price, at 5 to 15% of the price of drinking water. Overall, there is a clear preference for lower prices for reused water, and low tolerance to high prices.

Question 15. How much do you estimate that it would cost to perform a reutilization treatment on wastewaters? (All stakeholders)



All respondents agree on a price lower than 10€ per m^3 of reclaimed water, with roughly half setting a price somewhere between 5 and 10€, and the other half setting a price under 5€. Once again, these numbers provide concrete data about the needs of the surveyed stakeholders.

Question 16. Who do you believe should bear the cost of use of reclaimed waters? (All stakeholders)



Overwhelmingly, stakeholders agreed that the end user should bear the cost of use of reclaimed waters.

3.3. France Living Lab Survey results

In order to better identify the demand for treated water among farmers in Ariège, a survey was conducted both in person and online. The graphs below are based on 10 responses collected at the Saint-Girons market in Ariège, as well as 2 responses obtained online.

This questionnaire covers several key topics:

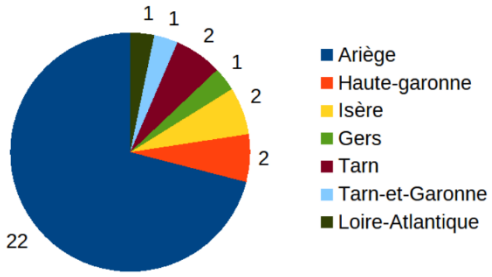
- Location
- Interest in water recycling
- Potential sources of reusable water

- Required and recyclable water volumes
- Uses of recycled water
- Accessibility
- Nature-Based Solutions

In this section, we will present the survey questions by category and provide a brief discussion of the responses obtained.

3.3.1. Location

Question 1. What is your country and region?



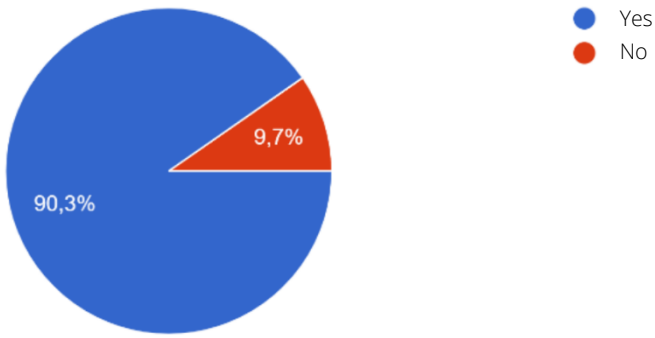
The vast majority of respondents came from the Ariège, which includes the Couserans territories. In Ariège, the majority of respondents were from Saint-Girons (the largest city in the Couserans territory). Others came from other departments, mostly located in southern France. Since all answers were collected from face to face interviews, most of these outsiders were encountered in the markets for products sailing in Ariège.

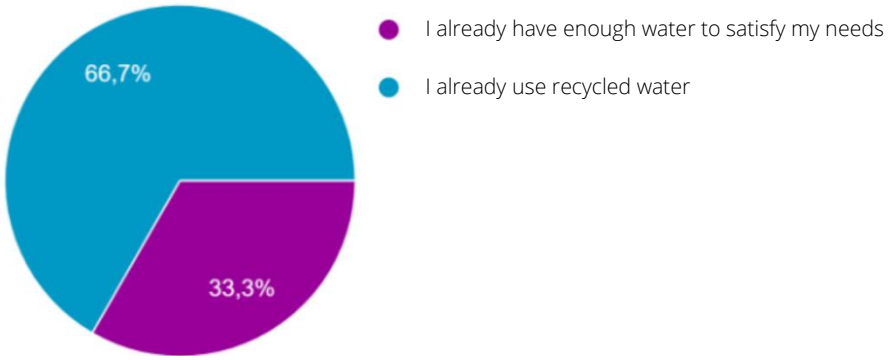
Question 2. What city do you live in?

Answers to this question are not reported here as they are not relevant to the deliverable.

3.3.2. Interest in water recycling

Question 3. Would you be interested in water recycling solutions for your farm?

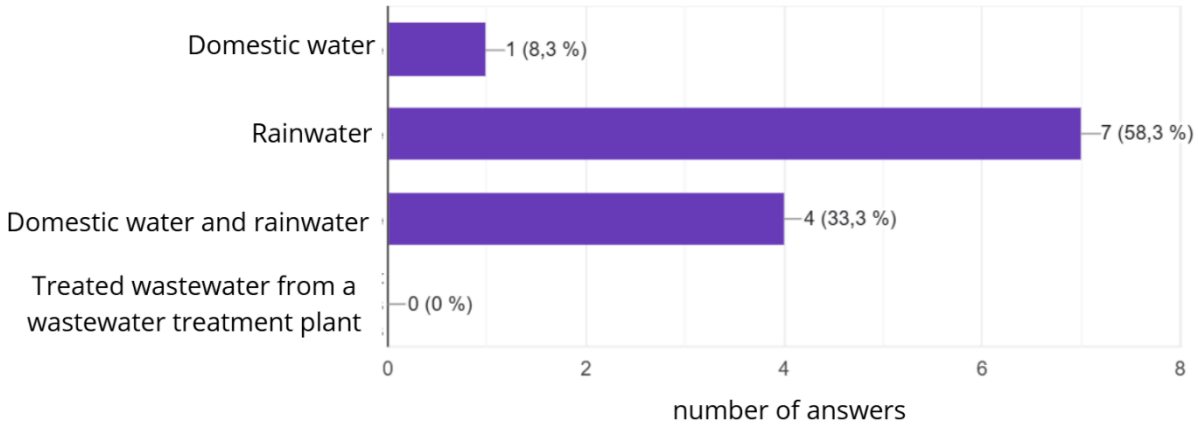




A large majority of respondents (90%) expressed interest in implementing water recycling solutions on their farms. Of those who answered no, 66.7% said they already use recycled water on their farms, and the rest claim to have enough water (delivered from springs or pumped from rivers) to satisfy their needs.

3.3.3. Potential sources of reusable water

Question 4. Which water sources represent a potential for recycling on your farm?

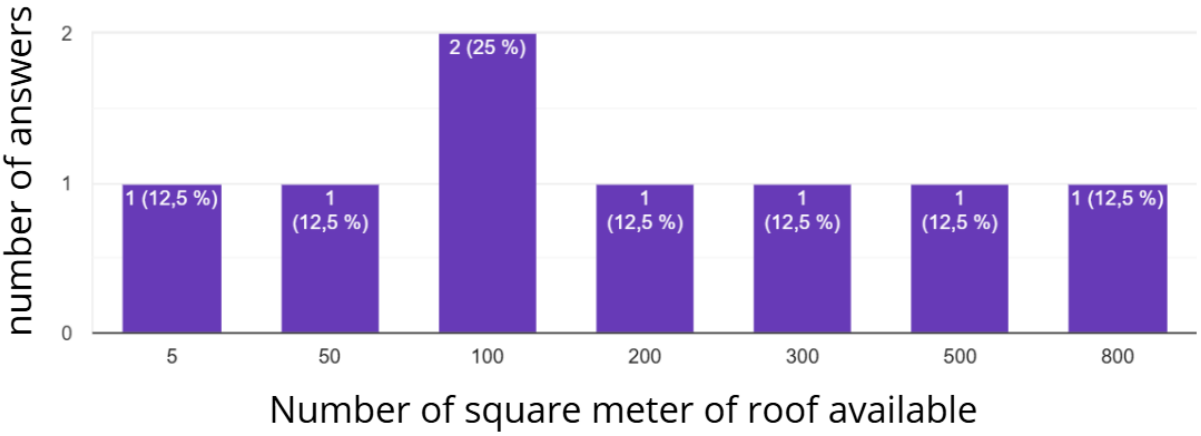


The majority of respondents (58%) only plan to collect rainwater as a source of reusable water; 33.3% plan to reuse both rainwater and domestic water, and 8.3% can only reuse domestic water. No respondents chose treated wastewater from a wastewater treatment plant as a source for reuse. Rainwater collected from farms and agricultural buildings appears to be the most common water source, likely due to ease of access and the high quality associated with this water, but there is a non-negligible percentage that is able to use domestic water as well.

3.3.4. Required and recyclable water volumes

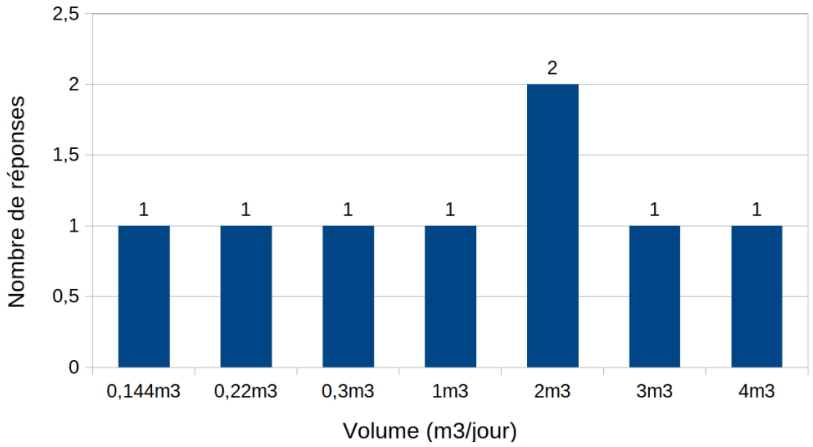
Question 5. How much water could you collect on site for recycling?

Question 5.1. How many m^2 of roof surface do you have available?



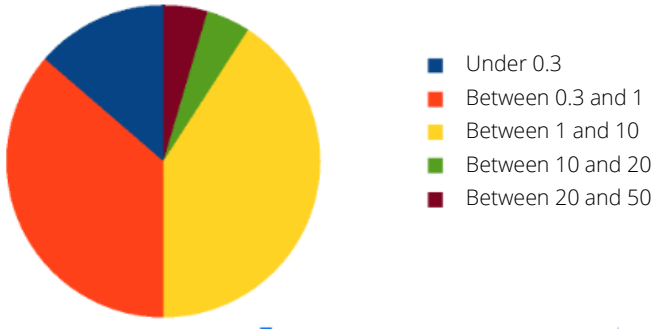
Answers were very varied, ranging from 5 m^2 to 800 m^2, which shows the large diversity of agricultural organisation, from very small farms to large companies. Rainfall amounts range between 700 and 1000 mm/year in Saint Girons, with this amount increasing to between 1000 and 1800 mm/year in the mountains. Though the climate in the area is continental, there is an increasing tendency towards droughts during the summer.

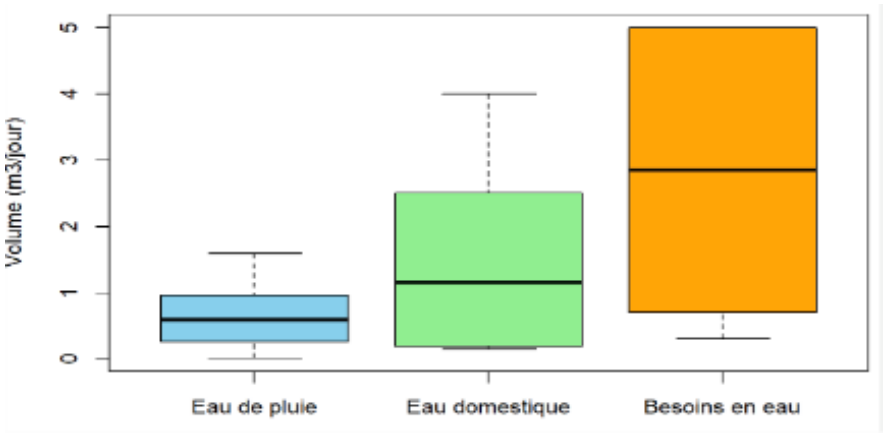
Question 5.2. What is the amount of m^3/day of domestic water you could collect?



20 respondents answered this question. The quantity of domestic water ranges from 0,3 to 10 m3/day, which corresponds to a family or a farm scale production. This is coherent with the respondents from the Couserans region, who were mostly farmers.

Question 6. What is the amount of water in m^3/day you would need in case of a drought?

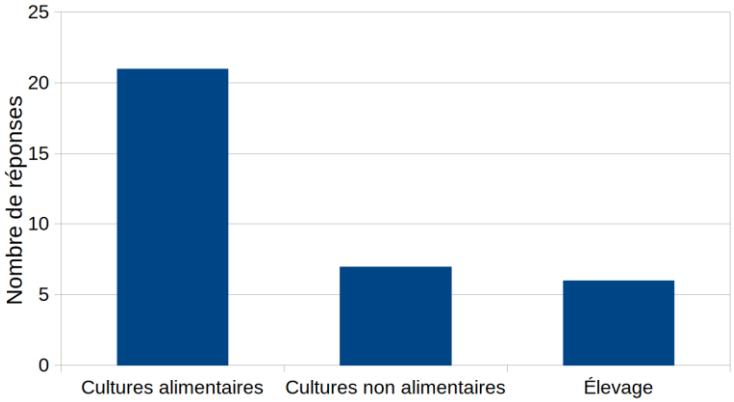




The survey results show that the majority of respondents need around 3 m3 of water per day during a drought. The box plot compares this need (orange) with the available rainwater (blue) and domestic water (green) sources. The graph shows that, in general, the demand for recycled water at the farm scale could be covered by both water sources. This doesn't take into account the variability of rainwater availability, but the domestic source remains the larger amount of available water, with a fairly constant delivery over time. These results also sustain the development of a multisource delivery of water, mixing rainwater and domestic water, with quality and volume adapted to climate and needs.

3.3.5. Uses of recycled water

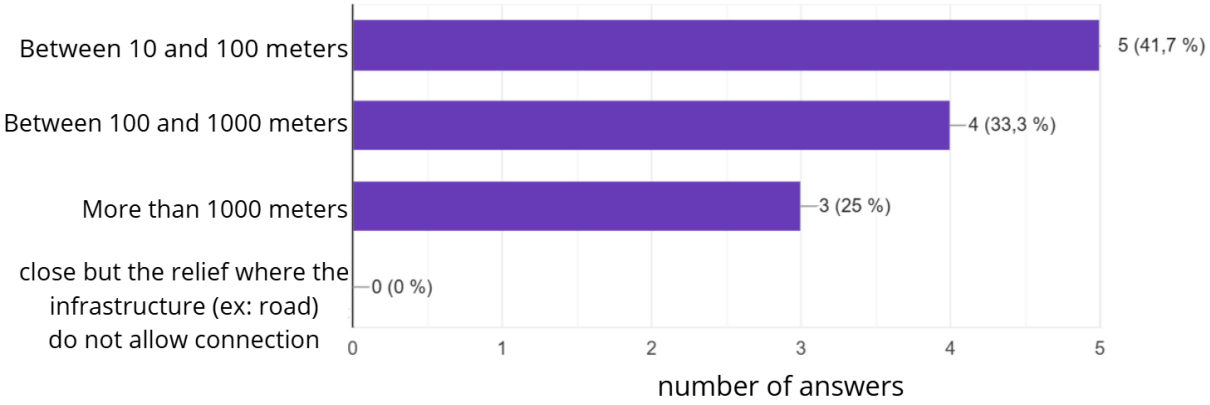
Question 7. What would you use recycled water for?



Responses show mostly food crops like fruits and vegetables, in keeping with the agricultural development of the Couserans region. Non-food crops (second column) such as horticulture and trees are in second place of need, though livestock use is also a significant need. This variety in needs is consistent with the agricultural production of the Couserans region, with a majority of small farms that tends to be polycultural producers.

3.3.6. Accessibility

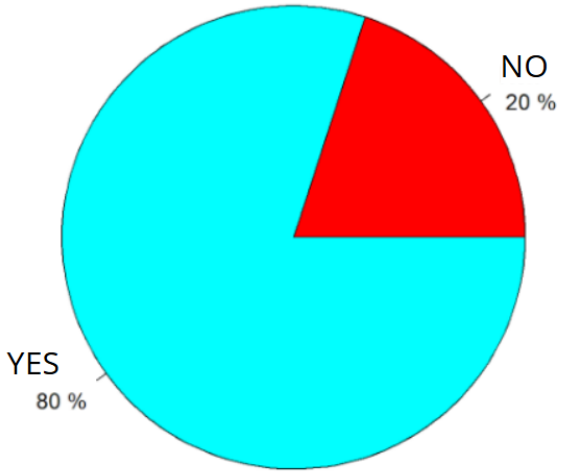
Question 8. What is the distance between the available water source and the place where the recycled water will be used?



Most of the answers collected come from close locations between water delivery and site of use. This is typically the case of farms where farmers live next to the irrigated fields and livestock. These results encourage the potential of local and non-collective water recycling at the scale of individuals or groups of farms that could lead to significant cost saving by short water network requirements.

3.3.7. Nature-Based Solutions

Question 9. Are you interested in developing new water recycling technologies based on nature (e.g. planted filters)?



80% of respondents showed interest in developing nature-based water recycling methods.

In summary, the results of this survey show that farmers living in remote areas far from towns and villages re interested in setting up a water recycling system. As we predicted, Couserans farmers live on their farms, so they have the possibility to recycle water, and the survey shows that they are keen on exploiting this potential, whether by reusing their domestic wastewater or using collected rainwater.

4. Stakeholder needs across the SUDOE region

4.1. Available water

In Spain and Portugal, farmers group themselves in large collectives which take water directly from the main water source (i.e. large rivers such as the Guadiana River), so these collectives do not have a pressing need to reuse water. The main source of reused water in these two countries is residual urban water (that is, domestic water) from urban wastewater treatment plants, though in Spain the amount of effluent flow that can be reused is limited on a case-by-case basis due to environmental flow considerations. Rainwater, meanwhile, is not a reliable source of water for these collectives due to irregular rain patterns in both Spain and Portugal, where rainfall throughout the year is infrequent and limited mostly to the winter months.

In France, meanwhile, specifically the case study of the Couserans region, which is characterised mostly by small farms, both domestic water from the farms themselves and rainwater recovered from roofs, or a mix of both, could serve as the source for reused waters, as seen in Question 6.1 of the French stakeholder survey. Unlike Spain and Portugal, France experiences more even rainfall patterns throughout the year, which makes rainwater a more reliable source of reused water for French stakeholders. In this context, the collective production of water from wastewater treatment plants should be allocated to industrial purposes such as washing, cooling, or fire brigades.

In Spain, the amount of effluent flow that can be reused is limited on a case-by-case basis due to environmental flow considerations, but the Spanish stakeholder

survey shows that a majority of respondents (54%) believe that a reuse between 10 and 50% of WWTP effluent flow would be appropriate. There are no such limits in Portugal or France, where the amount of WWTP effluent flow that can be destined for reuse is not constrained. This difference arises not from environmental concerns, but rather from a view of the relationship between the natural water cycle and the anthropic water cycle. This point will be developed in Deliverable 3.1. about limitations for reuse. Rainwater, meanwhile, is not a reliable source of water for these collectives due to irregular rain patterns in both Spain and Portugal, where rainfall throughout the year is infrequent and limited mostly to the winter months. In the Couserans region, the use of rainwater and mixed water sources is more frequent and emerging as a more flexible and adaptable way to cope with future climate conditions than a single source of water.

Therefore, it can be concluded that, because of distinct social contexts in the rural areas of the SUDOE region, the main source of reclaimed water in Spain and Portugal would be the effluent flow from wastewater treatment plants, whereas in the French Couseran context the main source would be the local production from farms or groups of farms. There is no competition between these collective and non collective ways to plan water reuse; both arrangements could be viewed as complementary solutions that can work simultaneously to answer the demand of water with its spectrum of uses, while also providing the advantage of limiting the cost of water networks when farms are isolated in the countryside.

4.2. Needed water

Referring back to Question 7 of the French stakeholder survey, the reported needed water amounts in the event of a drought are varied, but they range from a minimum

of 20 m^3/day to 100 m^3/day or more. The largest respondent block, which constituted 36% of respondents, indicated a need between 50 and 100 m^3/day.

As for the needed amounts reported in the Portuguese survey, responses to Question 5 were varied and many chose not to respond. Still, 19% of respondents reported needing over 200 m^3/day, 14% reported needing under 50 m^3/day, and 9.5% reported needing between 50 and 100 m^3/day. Responses to a similar question in the Spanish survey, Question 3, were far more centralised towards the 50 to 100 m^3/day option, although higher amounts were considered by a substantial number of respondents.

With these results in mind, though no amount is a perfect representation of stakeholder needs in all three regions, the 50 to 100 m^3/day range seems like the most broadly representative, with the added clarification that a significant amount of stakeholders (20% in Portugal, 27% in Spain, and 18% in France) claimed to need higher amounts, going even above 200 m^3/day in some cases.

The demands of the three countries are also different regarding the main purpose of the reused water.

Figure 12. In France, farmers live in their own farms, where local water recycling is possible. In Spain and Portugal, the collective organisation for water provisioning is located in villages, so water recycling for urban and agricultural use is possible in the village surroundings.

Whereas the main focus of water reuse is on urban applications in the case of Portugal, Spain and France put a larger focus on agricultural use. Meanwhile, while Portugal and Spain have a more collective concept of water reuse, France also has the possibility of non-collective reuse, which enhances the possibility to reutilise water in non-urban contexts.

4.3. Accessibility

Answers to Question 11 in the Spanish survey point to a need for reclaimed waters to be pumped to the site of use rather than used in situ; this also coincides with the results of the Portuguese survey as seen in Question 18. This is quite different from the situation among the surveyed French stakeholders, where around 42% of respondents said the water source is within 100 metres of the point of use, pointing towards a preference for use in situ.

It can be concluded that the collective approach to reuse is more related to the end of pipe strategy and appears to be most relevant in Spain and Portugal. In the Spanish case only, the amount of water that can be reused is limited by legislation due to environmental flow considerations. In France, the location of houses next to the demand for crop or garden irrigation makes it possible to develop smaller water recycling solutions at the scale of farms or groups of farms in addition to the collective approach; however, the cost of the pipes needed to deliver water produced in wastewater treatment plants poses an evident limit for the use of this type of water in the Couserans region to farmers located in the vicinity of the WWTP.

4.4. Quality

In Spain and Portugal, where the source of reclaimed waters is urban water processed through urban wastewater treatment plants, the quality requirements for reused

water are dictated by national laws, which are in turn subject to European guidelines. However, stakeholders in both countries largely agreed that these quality requirements could be adjusted depending on the intended use for said waters, as seen in Questions 9 and 4 of the Portuguese and Spanish surveys respectively, though most stakeholders also agreed that a prior risk assessment would be necessary.

The French workshop provided information regarding water quality with real concerns from all stakeholders to identify who should be in charge of surveying water quality. The requirements for the quality of reused waters in France is slightly stricter than the European guidelines which increases confidence among stakeholders, but there is still a gap in the management strategy about the identification of which stakeholders are responsible for running the relevant water quality analyses in case of local or municipality reuse.

5. Conclusions

Although the Living Labs workshops across all three countries had similar compositions with a large number of attendants being public authorities, the responses to the online surveys were quite different. This is largely because of differences in the surveys themselves, as well as differences in the respondents, who were mostly public authorities and researchers in the Spanish and Portuguese surveys, and farmers in the French survey. The differences in context between the three countries also contribute to these disparities. Despite these differences, general trends do emerge, revealing some commonalities in the responses.

During the Living Labs events, stakeholders across countries agreed on a few different topics. One of them was the issue of the lack of public confidence in the safety of recycled water. Stakeholders agreed that there should be more work put into improving the public's opinion on this issue through awareness campaigns and other methods. Many stakeholders were also of the opinion that the administrative processes involved with the access to recycled water (such as obtaining permits) are too complex and should be streamlined. Stakeholders also agreed that there should be an effort made in incentivising the use of recycled water through various methods such as grants, and that the use of drinking water should be replaced with recycled water wherever possible. Another common concern was the need to preserve and protect the environment as well as the natural water resources.

Regarding the results of the online surveys, it is clear that respondents across all three countries are largely supportive of water reuse. Where differences arise is in the potential applications: in Portugal, urban use was the most popular application

for reused water, whereas Spanish and French stakeholders leaned towards agricultural uses.

Regarding water needs, responses also varied. France had the largest disparity in water volume needs, with some respondents requiring large volumes. This disparity is likely linked to usage: those considering reuse for agricultural irrigation generally have higher needs than those planning for urban applications.

From a regulatory perspective, respondents support adapting the quality of treated wastewater to its intended use, which is already the case in France. However, the legislation on quality requirements remains largely or even completely unknown among the stakeholders. The limited knowledge of regulatory frameworks and technical procedures across all three countries highlights a need for targeted training and awareness-raising actions.

Acceptance of Nature-Based Solutions for water reuse also varies across countries. In France and Portugal, respondents were mostly in favour, whereas opinions were more divided in Spain, where many stakeholders remain unconvinced that green solutions alone are enough to provide the necessary level of quality. Still, Nature-Based Solutions appear to be a promising approach for sustainable water reuse, particularly when integrated with more conventional technologies.

Finally, similar constraints emerge from the Portuguese and Spanish surveys regarding the availability of space for reuse. Most respondents feel that they do not have enough space to install the necessary infrastructure. Additionally, finding enough storage space for treated wastewater represents a major challenge for many stakeholders.