LIFE PHOENIX - LIFE19 ENV/ES/000278
With the contribution of the LIFE Programme of the European Commission

Innovative cost-effective multibarrier treatments for reusing water for agricultural irrigation

LIFE PHOENIX Deliverable

D.C.3.3 Guidelines for social acceptance of water reuse

Project acronym:	LIFE PHOENIX
Project full title:	Innovative cost-effective multibarrier treatments for reusing water for agricultural irrigation
Grant agreement no.:	LIFE19 ENV/ES/000278
Responsible partner for deliverable:	CETIM
Contributing partners:	AQUALIA
Author(s):	Rebeca Varela Figueroa
Nature of deliverable[1]:	T
Dissemination level[2]:	PU
Delivery date:	28/02/25

Version control

Number	Date	Description	Publisher	Reviewer
1.0	27/02/25	First draft	CETIM	CETIM
2.0	28/02/25	Final version: review of formatting, tables, and figures.	CETIM	AQUALIA

[1] **Nature of Deliverable**: **P**= Prototype, **R**= Report, **S**= Specification, **T**= Tool, **O**= Other.

[2] **Dissemination level**: **PU** = Public, **RE** = Restricted to a group of the specified Consortium, **PP** = Restricted to other program participants (including Commission Services), **CO**= Confidential, only for members of the Consortium (including the Commission Services)

Contents

Acronyms

DPR: Direct potable reuse

EU: European Union

GRS: Groundwater Replenishment Scheme

GWRS: Groundwater Replenishment System

IRP: Indirect potable reuse

MCM: Million cubic meters

WWTP: Wastewater Treatment Plant

Figures

1 Introduction

The world and Europe in particular are grappling with a mounting water scarcity crisis. It is imperative to adopt innovative strategies like water reuse to safeguard the future of water resources. While technological advancements, such as the ones demonstrated in the Life Phoenix project, have significantly improved the feasibility of water reuse systems, their success depends on more than just the science—it hinges on gaining social acceptance. This often-overlooked aspect can ultimately dictate whether water reuse initiatives thrive or face rejection.

One of the central challenges to achieve widespread adoption of water reuse practices is the so-called "yuck factor." This refers to the instinctive unease or emotional resistance that people may experience when confronted with the idea of using treated wastewater. Despite rigorous treatment processes that ensures recycled water to meet or even surpass safety and health standards, public perception may still skew toward suspicion and discomfort. Addressing this psychological barrier requires robust education campaigns, openness about water treatment technologies, and clear communication to demonstrate the reliability and safety of reused water.

This document offers practical guidance for overcoming societal resistance to water reuse, using lessons learned from European and international case studies. These examples emphasize the pivotal roles of community engagement, inclusive stakeholder collaboration, and transparent messaging in fostering trust and shifting public attitudes. By mitigating the "yuck factor" and building confidence in water reuse as a safe and sustainable practice, its potential to combat water scarcity effectively can be unlocked.

2 The importance of social acceptance of water reuse

2.1 General aspects

If has long been discussed that social acceptance, often referred as the “yuck factor”, can act as one of the main barriers for the mainstream of water reuse as a solution to water scarcity.

The "yuck factor" refers to the emotional and psychological discomfort that people may feel when considering the reuse of treated wastewater, especially for purposes like drinking or bathing. It is a term used to describe the natural aversion that people have towards the idea of using water that has been previously used, even if it has been treated and purified to meet health and safety standards.

This discomfort can stem from the perception that water might still be "contaminated" or unsafe, even though modern treatment technologies can remove harmful substances. The yuck factor is often influenced by cultural beliefs, personal experiences, and the inherent ickiness people

associate with recycled water, regardless of its actual quality. Overcoming this psychological barrier requires education, transparency, in addition to clear communication about the effectiveness of water treatment processes and the safety of the water being reused.[3]

This factor has a potential impact on the widespread of water reuse initiatives. Indeed, the "yuck factor" represents a strong emotional and psychological resistance to the concept of reusing treated wastewater. This resistance often is not based on scientific evidence or concerns about safety. By contrast it is based on feelings of unease associated with the idea of using water that was previously used for something else. This discomfort can significantly slow down the adoption of water reuse initiatives mainly in relation to the following issues:

- **Hesitation about drinking or using recycled water**: Even if treated wastewater meets or surpasses drinking or freshwater safety standards, many people are still uneasy about consuming it. This hesitation leads to the perception that water previously used for sewage or industrial processes is inherently unsafe, deploying a strong opposition to water reuse projects for drinking purposes.

- **Cultural and psychological influences**: Cultural norms often equate "clean water" with freshness and purity, which makes the concept of reusing water seem unappealing. Psychological barriers, such as discomfort or disgust, can persist even against the scientific confirmation of safety.
- **Challenges in communication**: Public outreach efforts that explain the advanced processes used to treat wastewater often don't succeed against the deep-seated emotional reactions of the "yuck factor." Distrust in institutions or fear of the unknown can also exacerbate resistance.
- **Impact on policy decisions:** Policymakers often hesitate to push forward with water reuse programs if they anticipate public backlash rooted in the "yuck factor." This hesitation can delay vital infrastructure development, despite the environmental and financial advantages of these initiatives.
- **Economic and Financial Constraints**: When communities or regions face opposition to treated wastewater reuse due to the "yuck factor," the financial resources that might be needed for public education campaigns or alternative solutions may be diverted to other initiatives that receive more public support. The reluctance to accept treated water can make it more difficult to justify the investment needed to build the infrastructure for widespread reuse.
- **Perceived Risk and Trust Issues:** The "yuck factor" can be linked to a deeper distrust of institutions or technologies involved in water treatment. If people untrust the agencies

[3] Po, M., Kaercher, J. D., & Nancarrow, B. E. (2003). Australian water recycling guidelines: A review of the social issues and public acceptance. Water Science and Technology, 47(9), 147-153.

managing water resources or the processes used to treat wastewater, they may assume that there is a higher risk involved in using treated water. This sense of mistrust can perpetuate scepticism about the safety of recycled water, even in the face of evidence to the contrary.

2.2 Use cases of social acceptance impact on water reuse initiatives

Social acceptance plays a critical role in the success or failure of water reuse initiatives. Several cases have demonstrated how public attitudes, trust, and perceptions can either facilitate or hinder the adoption of water recycling programs. Here are some examples where social acceptance significantly influenced water reuse projects:

Figure 1 Protesters against a sewage water reuse plant (Source: BBC)

2.2.1 International examples

2.2.1.1 TOOWOOMBA, AUSTRALIA: REJECTED DIRECT POTABLE WATER REUSE[4]

In 2006, Toowoomba, a city in Queensland, Australia, proposed an indirect reuse via dam mixing water scheme. This initiative was part of a broader strategy to address water shortages caused by a severe drought. The plan was to treat wastewater to a high standard and then add it to the dam supplying drinking water.

Despite technical assurances regarding water safety, the project faced strong opposition from the public. The "yuck factor" was a significant obstacle, with residents expressing strong discomfort about drinking recycled wastewater. Public fear and scepticism about the safety of the treated water overshadowed the scientific evidence supporting the initiative.

Due to the intense opposition and lack of public support, the Toowoomba City Council held a referendum, and the proposal was rejected by voters. This case highlights how social acceptance

[4] https://www.austlii.edu.au/au/journals/ALRCRefJl/2006/37.pdf

can be a decisive factor in the success of water reuse projects, especially when the public is not fully on board with the idea of drinking recycled water.

2.2.1.2 ORANGE COUNTY, USA: SUCCESSFUL INDIRECT POTABLE REUSE (IRP)[5]

Orange County, California, faced severe water scarcity issues, and in 2008, the county launched the Groundwater Replenishment System (GWRS), a large-scale indirect potable reuse project. This system treats wastewater at very high standards and injects it into the groundwater supply to replenish drinking water sources.

Figure 2 Orange County Groundwater Replenishment System

Initially, there was some public hesitation and concern regarding the safety of recycled water. Many people had concerns about using treated wastewater, even though scientific studies indicated it was safe for consumption. The "yuck factor" was a barrier, especially when the water was intended to enter the drinking water supply.

Despite the initial concerns, the project succeeded because of strong public outreach and education campaigns. The Orange County Water District worked to inform the public about the treatment process, emphasizing the advanced technology and high safety standards. As a result, the project gained broad acceptance., Today it serves as one of the largest and most successful water reuse programs in the world. This case shows how effective communication and public engagement can overcome resistance to water reuse.

2.2.1.3 SINGAPORE: SUCCESSFUL INTEGRATION OF RECYCLED WATER (NEWATER)[6]

Singapore's NEWater program is a highly successful example of water reuse for potable purposes. Faced with limited natural freshwater resources, Singapore invested in advanced water treatment technologies to recycle wastewater, producing NEWater, which is used for industrial purposes and as a direct source of potable water.

Initially, the public had reservations about drinking treated wastewater, driven by the "yuck factor". However, the government made a concerted effort to educate the public about the safety of the water through transparent communication, public engagement, and scientific demonstrations.

[5] https://www.asersagua.es/Asersa/Documentos/IWater%20Presentation%20Barcelona%20Final%20MPatel.pdf
[6] https://www.pub.gov.sg/Public/WaterLoop/OurWaterStory/NEWater

Over time, public perceptions shifted, and the initiative gained broad acceptance. The government's clear communication about the safety and benefits of recycled water, along with its integration into the broader water supply system, led to Singapore becoming a global leader in water reuse. Today, NEWater is widely accepted as a critical component of Singapore's water strategy, demonstrating how education and consistent public engagement can overcome initial resistance.

2.2.1.4 WINDHOEK, NAMIBIA: PIONEERING DIRECT POTABLE REUSE[7]

Windhoek, the capital city of Namibia, has been using direct potable water reuse (DPR) since 1968. Faced with chronic water scarcity, the city implemented a system where treated wastewater is returned to the drinking water supply after undergoing advanced treatment processes.

Windhoek's direct potable reuse initiative initially faced scepticism and concerns about the safety of drinking water that had been used by others. However, over the years, the city's government worked to address these concerns through education, transparency, and demonstration of the effectiveness of the treatment processes.

Windhoek's DPR system has been operational for decades and is widely accepted today as a successful example of water reuse. The success of this program is attributed to long-term public education campaigns and the gradual building of trust between the public and the local water authorities. This example also illustrates how persistence in educating the public and ensuring transparency can lead to widespread acceptance, even in a culturally sensitive context.

2.2.1.5 TUCSON, USA: THE "RECLAIMED WATER" INITIATIVE FACES RESISTANCE[8]

In Tucson, Arizona, efforts to implement water reuse systems, such as using reclaimed water for irrigation and industrial uses, have been met with mixed reactions. While the idea of using recycled water for non-potable purposes like irrigation is generally accepted, there has been resistance when it comes to using treated wastewater for potable purposes. The public's resistance to drinking recycled water has been a major challenge for expanding water reuse projects. The "yuck factor" and concerns about the safety of reclaimed water have slowed the adoption of potable reuse systems in the area.

While non-potable water reuse for irrigation and landscaping has become more common, direct potable reuse is still facing challenges in gaining widespread acceptance. However, efforts are underway to educate the public, and gradually expand the water reuse systems for non-potable purposes to eventually leading to broader acceptance of potable water reuse.

[7] https://www.fluencecorp.com/recycling-wastewater-in-namibia/

[8] https://www.tucsonaz.gov/Departments/Water/Water-Resources-and-Drought-Preparedness/Reclaimed-Water#:~:text=What%20is%20reclaimed%20water%20for,the%20Santa%20Cruz%20Heritage%20Project.

2.2.1.6 PERTH, AUSTRALIA: THE "GROUNDWATER REPLENISHMENT SCHEME"[9]

Perth, Western Australia, introduced its Groundwater Replenishment Scheme (GRS) in 2017, which treats wastewater to a high standard and injects it into underground aquifers. The initiative aims to address water scarcity in a region that frequently experiences drought conditions.

There was significant public concern about using recycled water, particularly when it was intended to enter the potable water supply chain. The "yuck factor" played a role, with many residents questioning whether it was safe to drink water that had been used previously by others.

Public acceptance of the scheme was facilitated by extensive community consultation, transparent information about the treatment process, and emphasis on the high quality of the recycled water. Although the project faced initial scepticism, it is now widely accepted and serves as a critical component of Perth's water supply strategy. This example highlights the importance of public education and transparency to overcome resistance to water reuse.

These examples demonstrate that social acceptance can make or break water reuse initiatives. When the public is sceptical or opposed to using treated wastewater, projects are often delayed or rejected, as seen in Toowoomba. On the other hand, with effective communication, transparency, and ongoing public engagement, initiatives can gain acceptance and succeed, as evidenced in places like Orange County, Singapore, and Windhoek. Not only overcoming the "yuck factor" but also building trust with the public are essential steps in making water reuse a viable and sustainable solution to water scarcity.

2.2.2 European examples

2.2.2.1 BARCELONA, SPAIN: THE ZERO WATER INITIATIVE[10]

Barcelona has faced ongoing water scarcity issues, particularly due to droughts, consequently, the city has implemented various water reuse programs. One initiative is the use of treated wastewater for non-potable purposes like irrigation, industrial use, and street cleaning. The city has also explored the use of advanced treatment technologies for integrating treated wastewater into urban water systems, including the possibility of potable reuse.

Public acceptance of water reuse in Barcelona has been relatively positive, especially for non-potable uses. However, there has been hesitance around the idea of drinking treated wastewater. The "yuck factor" and concerns about water safety have made the public more comfortable with

[9] https://water360.com.au/case-study/draft-perth-groundwater-replenishment-scheme/
[10] https://aiguesdebarcelona.cat/es/web/ab-corporativa/-/agua-regenerada-polo-besos

Figure 3 Barcelona awarness campaing

using recycled water for irrigation and industrial purposes but less willing to accept it for direct potable use.

The city has made significant advances in promoting non-potable reuse, and public acceptance has been growing. Barcelona has also worked to build trust through transparency and showcasing successful examples of water recycling. In 2016, the city introduced a new public education campaign to further promote water reuse as a critical solution to water scarcity. While direct potable reuse hasn't been fully implemented, Barcelona's example shows how the gradual expansion of water reuse programs can gain broader acceptance through consistent engagement and education.

2.2.2.2 SWITZERLAND: THE ZURICH WATER RECYCLING INITIATIVE[11]

Zurich has been exploring various water reuse systems to address water scarcity. The city has invested in water treatment technologies that recycle water for use in industrial processes, landscaping, and cleaning purposes. Additionally, Switzerland has long been focused on efficient water use and environmental sustainability, which aligns well with water reuse initiatives.

While there has been some public resistance to the idea of drinking treated wastewater, water reuse for industrial and non-potable purposes has generally been accepted by the population. However, social acceptance of potable water reuse remains a challenge due to the "yuck factor," despite the technical feasibility of the systems in place.

Zurich has faced little resistance to using recycled water for non-potable applications. The city's focus on environmental sustainability and public education has allowed it to build public support for water reuse. However, direct potable reuse has not yet been fully implemented, reflecting the challenges of overcoming the psychological barriers that exist in many communities regarding the consumption of treated wastewater.

[11] https://www.eawag.ch/en/department/eng/projects/wasserwiederverwendung-schweiz

2.2.2.3 MALTA: WATER REUSE FOR IRRIGATION[12]

Malta, an island nation facing severe water scarcity, has adopted water reuse initiatives, particularly in the agricultural sector. Recycled water is used for irrigation, reducing the reliance on freshwater resources and improving agricultural sustainability. The country has also studied ways to integrate desalinated water with recycled water in its supply systems.

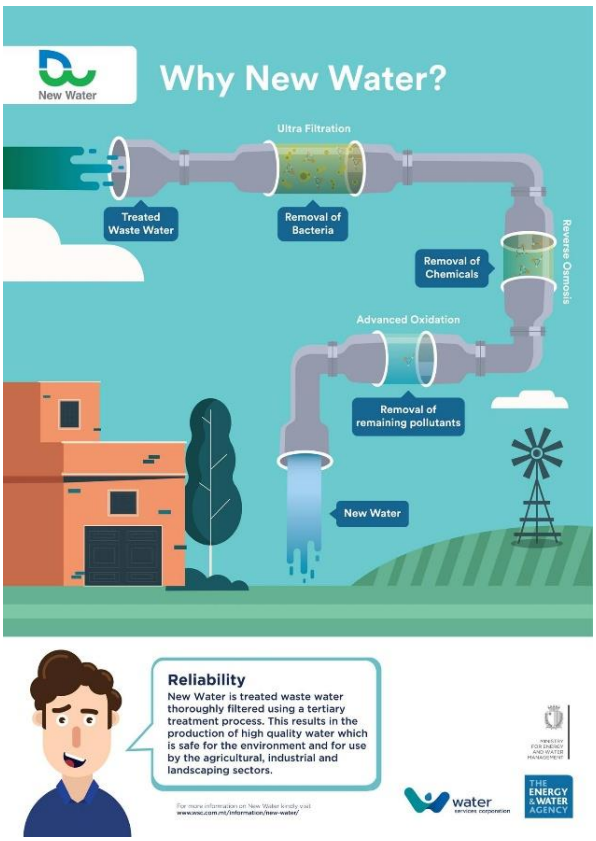

Figure 4 Example of a new water education campaign

Initially, there was public resistance to using recycled water for any purpose, especially for food production. The idea of using treated wastewater for agriculture sparked concerns about health risks and the safety of consuming crops grown with recycled water. However, the government and local agricultural organizations addressed these concerns emphasizing the rigorous safety standards and treatment processes involved.

Over time, Malta's water reuse programs have gained acceptance, particularly in agriculture. As more farmers see the benefits of using recycled water for irrigation, the public's perception has become more favourable. Educational campaigns and research into the safety of recycled water in food production helped overcome initial fears. The success of water reuse in Malta demonstrates how public education can help alleviate concerns about water safety and promote acceptance.

2.2.2.4 THE ALGARVE, PORTUGAL: TOURISM AND WATER REUSE[13]

The Algarve region in southern Portugal, a popular tourist destination, has implemented water reuse systems to cope with seasonal water shortages. The region uses treated wastewater for landscaping, golf course irrigation, and some industrial applications. The increased water demand

[12] https://water.europa.eu/freshwater/countries/uwwt/malta#:~:text=Does%20Malta%20reuse%20treated%20urban,agriculture%20and%20in%20the%20industry.

[13] https://www.sulinformacao.pt/2023/09/algarve-mais-que-duplica-reutilizacao-de-aguas-residuais-tratadas-com-obras-de-15-milhoes/

during the tourist season has led to the adoption of water reuse technologies to ensure a sustainable water supply.

While the idea of using recycled water for landscaping and golf courses has been generally accepted, there has been public hesitation about using treated wastewater for more direct applications, such as drinking or cooking. The fear of contamination and the "yuck factor" have caused some resistance to more widespread water reuse in public settings.

Despite these challenges, the Algarve has been successful with non-potable water reuse applications, especially for irrigation in agriculture and tourism-related industries. The region has also implemented educational campaigns to inform the public about the benefits and safety of recycled water. While potable reuse has not yet been fully adopted, the success in non-potable water reuse indicates that public perceptions can evolve with time and education.

These examples show that social acceptance is a dynamic and critical factor in determining the success of water reuse projects in Europe. With effective education, transparent communication, and gradual implementation, public attitudes can evolve, helping water reuse to become an integral part of sustainable water management in the region.

3 Status of social acceptance of water reuse in Europe

3.1 Analysis of country level situations

The social acceptance of reusing treated wastewater in Europe is gradually improving, though it varies across regions and applications. Surveys conducted in countries like Spain, the Netherlands, and the UK reveal that public support for using recycled water is higher than previously anticipated. For instance, in Spain, 73% of respondents supported its use for drinking purposes, and even more were open to consuming food grown with nutrients recovered from wastewater.

Indeed, some European countries have taken the lead in the implementation of water reuse initiatives, and this has been accompanied by extensive work to ensure social acceptance. This is the case of the following countries:

Spain is a pioneer in water reuse, particularly for agricultural irrigation. The country has developed advanced systems to treat wastewater, addressing water scarcity issues in arid regions. It currently accounts for nearly 50% of the total volume of reclaimed water in Europe, making it a benchmark in water reuse and ranks fifth globally in installed capacity for water reclamation[14]. Advanced technologies, such as membrane filtration and ultraviolet disinfection, are widely used to ensure high water quality standards for reuse. The country has implemented over 150 reuse projects and has a significant potential for water reuse, estimated at over 1,200 Mm^3 per year.

With regions like southeastern Spain experiencing some of the lowest rainfall levels in Europe, reclaimed water has become a critical resource. Investments in infrastructure and technology have allowed Spain to mitigate the impacts of drought and climate change effectively.[15] Within this context, the focus of water reuse in Spain is agriculture. Indeed, a significant portion of reclaimed water in Spain is used for agriculture, particularly in arid regions like Murcia, Andalucia, and the Canary Islands. For example, Murcia reuses 98% of its wastewater, meeting 15% of its irrigation needs. This system has been internationally recognized as a model for sustainable water management.[16]

This continuous development of water reuse has been coupled with acceptance by public opinion in the country. Indeed, social acceptance of water reuse in Spain has generally been positive, especially compared to other countries. Surveys indicate that around 73% of Spaniards support the use of recycled water even for drinking purposes, which is relatively high.[17] Interestingly, the

[14] https://idadesal.org/water-reuse-in-spain/
[15] https://iwaponline.com/jwrd/article/8/2/153/38035/Water-reuse-and-desalination-in-Spain-challenges
[16] https://phys.org/news/2023-06-spain-crops-wastewater.html#google_vignette
https://suwanu-europe.eu/reclaimed-water-an-alternative-for-the-irrigation-in-spain/
[17] https://aspe.org/pipeline/new-surveys-reveal-that-social-acceptance-of-water-reuse-isnt-the-biggest-challenge/

"yuck factor"—a common barrier to water reuse acceptance—is less pronounced in Spain than in some other regions. This can be attributed to the country's long-standing experience with water scarcity and its proactive approach to sustainable water management.

In the case of reuse of water in the agriculture field, Acceptance is generally positive, especially in regions facing water scarcity. Farmers recognize the benefits of reclaimed water for irrigation, such as its reliability and cost-effectiveness. However, challenges remain, including concerns about water quality and the costs of infrastructure for treatment and distribution.

Efforts to improve public perception include educational campaigns and government regulations ensuring high standards for reclaimed water. These initiatives aim to build trust and encourage wider adoption of water reuse practices. Some examples of specific public perception campaigns conducted in Spain are presented below:

- Murcia's School Program: In Murcia, a program targeted fourth and sixth-grade students to teach them about the importance of regenerating and reusing urban water. The initiative emphasizes environmental protection and personal responsibility in water usage.
- SUWANU EUROPE Regional Workshops: These workshops, held in Córdoba and Málaga, brought together key stakeholders in the water and agriculture sectors. They focused on discussing strategies for reclaimed water use and included educational components to inform participants about its benefits. As part of the workshops, the REGENERA Plan was developed to outline measures for the use of reclaimed water in agriculture. It includes educational efforts to engage the community and promote sustainable water management.
- Reclamagua in Tenerife: This policy focuses on raising awareness about wastewater reuse to combat water scarcity on the island. It includes educational efforts to inform residents about the importance of water reuse and its role in addressing droughts[18].

Italy and Cyprus can be also highlighted as early adopters of water reuse in the European Union. In the case of Italy, it was the first European country to legislate water reuse, with regulations introduced as early as 1977 for agricultural irrigation. This legislation described extensive treatment processes but did not stablished limits for toxic compounds. Subsequent updates, such as the 2003 decree, established strict parameters for water quality and expanded reuse categories to include industrial uses and street cleaning[19].

Despite its pioneering role, Italy's actual implementation of water reuse lags other European countries like Spain and Cyprus. Italy reuses only about 4–5%[20] of its treated wastewater,

[18] https://www.urbanwateratlas.com/2024/12/11/reclamagua-a-wastewater-reuse-policy-for-tenerife-spain/
[19] https://iwaponline.com/jwrd/article/14/2/115/101759/Will-the-European-Regulation-for-water-reuse-for
[20] https://www.nuoveenergie.it/en/news/drought-italy-we-reuse-just-4-wastewater

compared to Spain's higher reuse rates (15 – 30%) and Cyprus' nearly complete reuse of wastewater. While Italy has advanced wastewater treatment facilities and significant potential for reuse (up to 475 million cubic meters annually), bureaucratic hurdles and insufficient investment have limited its progress[21].

As for social acceptance, it is gradually improving, especially in agriculture and is variable depending on the region. In regions like Apulia, stakeholders, including farmers and citizens, show high levels of acceptance for wastewater reuse. Surveys indicate that 59% of farmers and 87% of citizens are open to using treated wastewater occasionally, particularly for agricultural purposes. However, concerns about health risks from chemical substances and diseases persist among some stakeholders[22]. In other regions public resistance to water reuse in agriculture stems from emotional reluctance and concerns about safety. Italians are generally hesitant to use treated wastewater due to perceived risks, despite advancements in purification technologies. Awareness campaigns and risk mitigation strategies are needed as ways to improve public attitudes[23].

The list of leaders in water reuse in Europe is closed by **Cyprus**, driven by severe water scarcity and the need for sustainable water management. In 2023, Cyprus reclaimed approximately 29 million cubic meters (MCM) of treated wastewater[24]. Two-thirds of this was used for agricultural irrigation, while the remainder was allocated for aquifer recharge. Currently, reclaimed water covers about 15% of total irrigation needs, with projections to reach 25% by 2025. By 2027, reclaimed water production is expected to increase to 74 MCM annually[25]. Most of the countries advanced wastewater treatment plants are equipped with tertiary treatment systems to ensure safe reuse for irrigation and aquifer recharge[26].

To achieve this level of implementation of water reuse, Cyprus has been working for a long time. Initiated in the late 1960s, the Water Master Plan included measures such as leakage reduction, improved irrigation efficiency, water pricing, and awareness campaigns to enhance water availability. In 1997, wastewater reuse was officially introduced in the plan, alongside desalination as unconventional water sources to address increasing demand and frequent droughts[27]. In line with this policy decisions, construction of wastewater treatment plants (WWTPs) with tertiary treatment systems was prioritized to ensure safe reuse for irrigation and aquifer recharge together

[21] https://www.mdpi.com/2071-1050/16/24/11277
[22] https://www.academia.edu/21932478/Wastewater_reuse_in_Italy
[23] https://brill.com/view/journals/jeep/18/3/article-p225_225.xml
[24] https://suwanu-europe.eu/wp-content/uploads/2021/06/Cyprus_Israel_stories.pdf
[25] https://suwanu-europe.eu/wp-content/uploads/2020/01/FS2_FactSheet_Cyprus_Wastewater.pdf
[26] https://www.moa.gov.cy/moa/wdd/WDD.nsf/72220409491904A1C2258AC9001E3439/$file/20231025_WATER%20MINING.pdf?OpenElement
[27] https://revolve.media/features/water-management-in-cyprus

with large-scale projects that included dams, urban WWTPs, and water conveyance systems to integrate reclaimed water into agricultural networks[25].

As for social acceptance, early scepticism among farmers was addressed through education campaigns, workshop, and demonstrations of benefits in practice. Public information initiatives included TV shows, school visits, informational leaflets, and social media posts to raise awareness about the advantages of water reuse. Recycled water was made cheaper than freshwater to encourage widespread adoption[24].

Conversely, there are other EU countries with minimal water reuse. This is the case of countries like Sweden, Estonia and others in Northern and Eastern Europe that have limited experience with water reuse. Freshwater resources are relatively abundant in these regions, reducing the urgency for reclaimed water reuse. In particular, seven EU countries have opted not to apply the water reuse opportunities outlined in the EU Water Reuse Regulation. These countries cite mainly geographical, climatic conditions, and low irrigation demand as reasons for their decision[28]. In detail:

- Finland: Freshwater resources are abundant, and irrigation demand is low, making water reuse unnecessary.
- Latvia: Like Finland, Latvia's geographical and climatic conditions reduce the need for reclaimed water
- Lithuania: The country has chosen not to implement water reuse due to sufficient freshwater availability.
- Poland: Water reuse is not prioritized because of low agricultural irrigation needs and resource costs
- Czech Republic: opted out, citing low irrigation demand and sufficient water resources
- Austria: decided against adopting water reuse practices due to abundant freshwater supplies
- Slovakia: Similar to Austria, Slovakia has adequate freshwater resources and does not see a need for reclaimed water.

Ireland and Denmark have yet to make a final decision on implementing water reuse regulations.

However, recent data indicate an increasing trend in drought occurrences throughout Europe. Thus, the annual extent of intense drought impacts in the EU shows an increasing trend despite

[28] https://environment.ec.europa.eu/topics/water/water-reuse_en

the 2023 recovery year as seen in Figure 4. The lower impact in northern and easter countries, being less affected nowadays, does not preclude those areas from an increase, as can be seen in Figure 5[29].

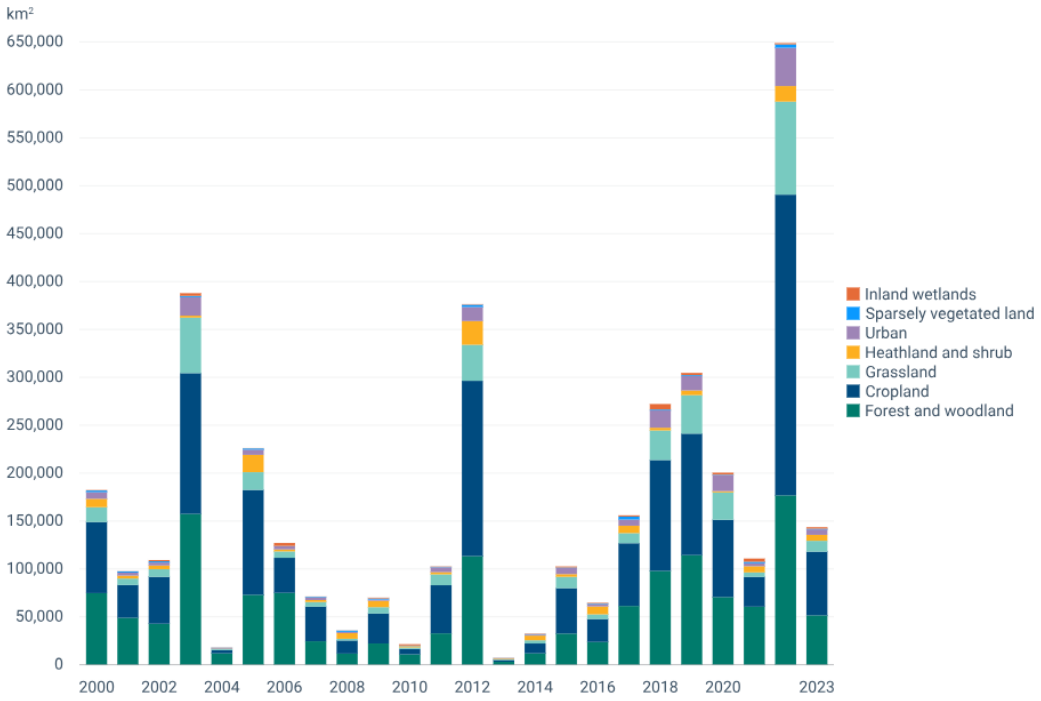

Figure 5 Area of drought impact on vegetation productivity in the EU-27 (Source EEA)

[29]https://www.eea.europa.eu/en/analysis/indicators/drought-impact-on-ecosystems-in-europe#:~:text=The%20annual%20extent%20of%20intense,ca%204%25%20of%20croplands).

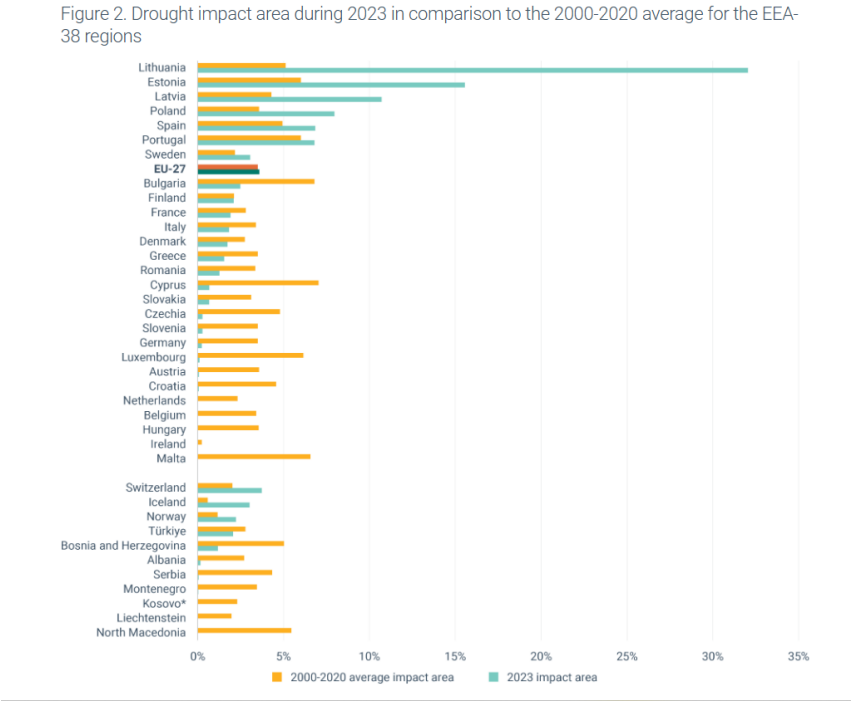

Figure 6 Drought impact area during 2023 compared to the 2000-2020 average (Source EEA)

3.2 Key takeaways from the EU experience

Across Europe, the success of water reuse initiatives often depends on the extent to which the public is informed and engaged. Educational campaigns and transparent communication have played key roles in building trust and overcoming the "yuck factor."

In many cases, public acceptance starts with non-potable water reuse (e.g., for irrigation or industrial use) and gradually expands to more sensitive areas like potable reuse. This phased approach allows the public to become more comfortable with the concept over time.

Cultural differences and regional attitudes toward water reuse influence the degree of social acceptance. For instance, the Netherlands and Switzerland have strong systems for agricultural reuse, while countries like Spain and Malta have made significant strides in tourism and agricultural water reuse. Addressing cultural and societal customs and finding ways to align water reuse initiatives with local values can help reduce resistance. This may include involving community leaders in promoting the benefits of treated wastewater or framing the issue in ways that resonate with local traditions.

However, challenges Remain for Potable Reuse. While non-potable water reuse is becoming more common and accepted, direct potable reuse (recycling wastewater to drinking water) remains a

more difficult concept for the public to embrace. The "yuck factor" is still a significant barrier, though initiatives in places like the Netherlands and Spain are beginning to explore indirect potable reuse as a potential solution.

3.3 Lessons learned from leading countries

Historically, the "yuck factor"—an emotional aversion to using treated wastewater—has been perceived as a major barrier. However, recent surveys conducted in Spain, the Netherlands, and the UK suggest that public attitudes toward water reuse may be more favourable than previously assumed. Trust in institutions and transparent governance have emerged as critical drivers of acceptance. Leading EU countries such as Spain, Cyprus, and the Netherlands provide valuable lessons on overcoming barriers through tailored strategies. Below is an exploration of key issues influencing social acceptance, integrated with specific examples from these countries.

3.3.1 Public Perception and Emotional Barriers

Public perception often hinges on emotional responses to the idea of using treated wastewater. The "yuck factor" stems from concerns about cleanliness, safety, and cultural taboos associated with wastewater use. While surveys reveal growing openness to water reuse—for example[30]:

- **Netherlands**: 75% of respondents supported recycled water for drinking purposes.
- **Spain**: 73% expressed similar support.

These findings suggest that public resistance may be less entrenched than previously thought. Countries like Cyprus have addressed this challenge through extensive awareness campaigns that normalize reclaimed water use for agriculture and aquifer recharge [31]. By emphasizing environmental necessity and safety standards, they have successfully mitigated emotional barriers.

3.3.2 Trust in Institutions

Trust in governmental agencies responsible for managing water reuse is crucial for public acceptance. Citizens are more likely to trust reuse initiatives if they believe these institutions can ensure high safety standards and reliable treatment processes. For example[30]:

[30] https://www.water-reuse-europe.org/new-surveys-reveal-that-social-acceptance-of-water-reuse-isnt-biggest-challenge/
[31] https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/water-recycling

- **Netherlands**: High trust in Dutch environmental agencies has significantly improved acceptance of potable reuse projects. Transparent governance and rigorous monitoring have reassured citizens about water quality.

- **Cyprus**: Authorities have built trust by showcasing successful aquifer recharge schemes with controlled monitoring systems.

These examples highlight that trust-building efforts are often more effective than simply educating the public.

3.3.3 Stakeholder Engagement

Engaging stakeholders—such as farmers, industries, local communities, and policymakers—early in the planning process ensures alignment of interests and reduces resistance. Collaborative decision-making fosters trust and allows stakeholders to voice their concerns about specific applications of reclaimed water. For instance:

- **Italy**: Regional working groups in areas like the Po Valley involved farmers, researchers, and policymakers in discussions about agricultural reuse projects. This participatory approach helped address concerns about crop safety while aligning diverse interests[32].

- **Cyprus**: Farmers were educated in small groups about the economic benefits of reclaimed water, addressing their scepticism directly[30].

Stakeholder engagement ensures decisions reflect collective values while building consensus around project goals.

3.3.4 Economic Incentives

Economic incentives play a significant role in driving adoption by making reclaimed water financially attractive compared to freshwater sources. For example:

- **Cyprus**: Reclaimed water was priced lower than freshwater to encourage its use for agriculture. This cost advantage motivated farmers to adopt reuse practices despite initial hesitation[30].

- **Spain**: Introduction of sanitation fees funded wastewater treatment upgrades while keeping reclaimed water affordable for end-users[32].

These measures lower financial barriers while highlighting cost-efficiency.

[32] https://brill.com/view/journals/jeep/18/3/article-p225_225.xml

3.3.5 Regulatory Frameworks

Clear regulations provide a foundation for scaling up water reuse projects by ensuring compliance with safety standards and simplifying bureaucratic processes. For instance[33]:

- **Spain**: Pioneering state regulations streamlined permits for reclaimed water use in agriculture, reducing delays and fostering confidence among stakeholders.
- **EU Regulation (2020/741)**: Sets minimum requirements for reclaimed water quality in agricultural irrigation but also encourages its use for industrial purposes and environmental initiatives.

Robust regulatory frameworks reassure stakeholders about the reliability of reclaimed water systems.

3.3.6 Communication Strategies

Effective communication is essential for dispelling myths about water reuse and educating citizens about its benefits[34]. For example:

- **Cyprus**: Public awareness campaigns—including workshops, school visits, and media outreach—have educated citizens on the benefits and safety of reclaimed water[31].
- **France**: Informational meetings were held as part of pilot projects in Occitanie to address public concerns about municipal uses of recycled water[32].

Highlighting successful case studies demonstrates tangible benefits while building credibility among sceptical audiences.

3.3.7 Demonstrating Practical Benefits

Successful small-scale projects such as LIFE PHOENIX where treated water is used in less sensitive areas (such as agriculture or industrial use) can help build public confidence. Seeing is believing, and once people observe the safety and effectiveness of water reuse in these contexts, they may become more open to the idea of expanding it to other uses[35]. For example:

- **Cyprus**: Authorities demonstrated successful aquifer recharge projects using reclaimed water, reinforcing public confidence over time.

[33] https://environment.ec.europa.eu/news/water-reuse-new-eu-rules-improve-access-safe-irrigation-2023-06-26_en
[34] https://www.cambridge.org/core/journals/environmental-conservation/article/recycled-water-reuse-what-factors-affect-public-acceptance/ADBC42E9C67BAAD812410E068FE651A3
[35] https://eyengineers.eu/wp-content/uploads/2022/07/Water-Reuse-in-a-Ciruclar-Economy.pdf

- **Spain**: Visible success in regions like Murcia where reclaimed water sustains agriculture has normalized its use among farmers who see direct economic gains.

Demonstrating tangible benefits alongside environmental advantages reinforces public confidence in adopting such practices.

In conclusion, promoting social acceptance of water reuse requires a multi-layered approach integrating governance, communication strategies, stakeholder engagement, economic incentives, and practical demonstrations of success. While emotional barriers like the "yuck factor" remain relevant, they can be mitigated through education campaigns that emphasize safety standards and environmental necessity.

4 Guidelines for social acceptance

Building on the analysis conducted so far and on the insights from leading EU nations and grounded in research, these recommendations focus on fostering acceptance and integrating reclaimed water into sustainable water resource management.

4.1 Improve Awareness and Normalize Water Reuse

Public attitudes toward water reuse are often influenced by emotional reactions, like the "yuck factor," rooted in cultural aversion and cleanliness concerns. To overcome these obstacles:

- **Educational Initiatives:** Develop campaigns to increase awareness about the safety, necessity, and ecological benefits of water reuse. Cyprus, for instance, normalized its use through school visits, workshops, and media promotion.
- **Showcase Success Stories:** Highlight examples where reclaimed water has been used effectively, such as Spain's agricultural practices in Murcia, which have bolstered confidence in reclaimed water.
- **Ensure Transparency:** Share detailed information about treatment methods and safety standards to alleviate health-related worries.

4.2 Build Trust and Institutional Credibility

Public trust in organizations managing water reuse is critical to gaining acceptance. Confidence grows when citizens are assured that institutions prioritize safety and reliability:

- **Transparent Administration:** Maintain open communication and detailed reports on water quality monitoring. For example, in the Netherlands, trust in government bodies has helped ease public concerns about reuse projects.
- **Independent Oversight:** Establish impartial agencies to monitor compliance with safety regulations, enhancing credibility.

4.3 Engage Stakeholders in Decision-Making

Involving diverse stakeholders helps align interests and mitigate opposition:

- **Collaborative Processes:** Involve farmers, industries, policymakers, and local communities in discussions on project objectives. Italy's participatory approaches in the Po Valley helped address resistance to agricultural reuse.
- **Tailored Outreach:** Educate specific groups, like farmers, about the financial advantages of reclaimed water. Cyprus employed targeted sessions to overcome initial scepticism among farmers.

4.4 Use Financial Incentives to Drive Adoption

Economic benefits can encourage the use of reclaimed water:

- **Discounted Pricing:** Offer reclaimed water at reduced rates compared to freshwater alternatives, as Cyprus has done to encourage agricultural usage.
- **Funding Assistance:** Provide financial aid to support municipalities and industries in adopting water reuse technologies.

4.5 Enforce Robust Regulatory Frameworks

Clear regulations form the backbone for scaling up water reuse projects:

- **Quality Standards:** Implement EU-wide minimum criteria for reclaimed water, as defined by Regulation (EU) 2020/741.
- **Simplified Procedures:** Streamline permitting processes to minimize delays—an approach that has facilitated agricultural reuse in Spain.

4.6 Develop Effective Communication Strategies

Strong communication efforts dispel myths and inform the public about reclaimed water's value:

- **Simplified Formats:** Use animations, infographics, and videos to simplify technical information.
- **Consistent Dialogue:** Maintain ongoing interaction with stakeholders throughout project phases to foster trust and long-term collaboration.

4.7 Showcase Real-World Advantages

Visible results reinforce confidence in water reuse's safety and utility:

- **Demonstration Projects:** Implement pilot initiatives such as LIFE PHOENIX to display successful applications.
- **Economic Benefits:** Highlight cost reductions and increased productivity achieved through reclaimed water use, demonstrated by Spain's agricultural sector.

Encouraging social acceptance of water reuse requires a cohesive and context-sensitive strategy. Policymakers can address public concerns through education campaigns, foster institutional trust with transparent practices, engage stakeholders, offer financial incentives, uphold clear regulations, communicate effectively, and highlight tangible benefits. These approaches align with the European Water Reuse Regulation's emphasis on safety and sustainability, while advancing resource efficiency and climate adaptation goals. By tailoring these methods to local circumstances, countries can promote sustainable water management practices that benefit both people and the environment.