

# Public Acceptance of Water Reuse for Agriculture in the Wake of the New EU Regulation: Early Reflections

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## Abstract

Domestic wastewater reuse in agriculture is often discussed as a way to tackle water scarcity in Europe. Europe could learn from the examples of other countries that are already successfully implementing wastewater reuse, especially in the Mediterranean. However, the potential of the practice is currently unfulfilled mainly due to social and legal barriers, including public resistance and the lack of a unified legislative framework at the European Union (EU) level. In the wake of the new EU Water Reuse Regulation released in June 2020, we wonder how this legislative intervention can foster public acceptance of non-conventional water reuse practices in agriculture. The original contribution of this piece is to provide a novel discussion of the transformations potentially triggered by the new EU Regulation and to suggest an innovative way forward, based on engaging interested users in water quality monitoring (i.e. water citizen science). We combine theoretical and empirical analysis, grounding our findings in an overarching theoretical concept, i.e. the neo-institutionalism theory. We conclude that the main catalysts for stimulating public acceptance can be identified in a unifying legislative tool represented by the recent EU Regulation and in the promotion of participatory water monitoring initiatives, also in line with the spirit of the EU Regulation.

## Keywords

EU Water Reuse Regulation – domestic wastewater reuse in agriculture – public acceptance – water citizen science – water monitoring technologies – water scarcity

### 1 Introduction

On June 26, the European Union (EU) Regulation 2020/741<sup>1</sup> of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse entered into force, bringing about a ground-breaking progress in the European legislative framework on non-conventional water resources treatment and application for agricultural irrigation. The Regulation – applicable for all EU Member States (MSs) from 26 June 2023 – is inserted within the new Circular Economy Action Plan<sup>2</sup> adopted in 2020 by the European Commission (EC), entailing a series of measures to boost circular economy in Europe.

On top of promoting a circular approach in agriculture, the Regulation intends to stimulate reliance on non-conventional sources of irrigation in light of the increasing occurrences of drought in numerous EU countries over the past thirty years. Water scarcity is indeed currently considered a major challenge for Europe,<sup>3</sup> and this scenario is rapidly being exacerbated due to the effects of climate change.<sup>4</sup> The EU has repeatedly stressed the need for policies to ensure access to water in sufficient quantity and good quality for all European residents. With the Communication 'Addressing the challenge of water scarcity and droughts in the European Union',<sup>5</sup> the EC launched an

1 Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse (Text with EEA relevance), PE/12/2020/INIT OJ L 177, 5.6.2020, p. 32–55. The text of the Regulation can be found here: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0741&from=EN>, accessed August 2, 2020.

2 Circular Economy Action Plan – The European Green Deal, the European Commission, 2020, [https://ec.europa.eu/environment/circular-economy/pdf/new\\_circular\\_economy\\_action\\_plan.pdf](https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf). Accessed November 10, 2020.

3 See <http://ec.europa.eu/environment/water/reuse.htm>. Accessed November 11, 2020.

4 G. Mancuso, S. Lavrić & A. Toscano, Reclaimed water to face agricultural water scarcity in the Mediterranean area: An overview using Sustainable Development Goals preliminary data, in P. Verlicchi (ed.) *Advances in Chemical Pollution, Environmental Management and Protection* 5, 2020, pp. 113–143.

5 European Commission, Addressing the challenge of water scarcity and droughts in the European Union, COM(2007) 414 final, <http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0414:FIN:EN:PDF>. Accessed November 1, 2020.

EU-wide Water Scarcity & Droughts policy, whose objectives – however – are far from being achieved.<sup>6</sup> The European residents, on their side, are increasingly becoming aware of the subject and demanding interventions, for example through the launch of a European Citizens' Initiative on water as a public good.<sup>7</sup>

In this scenario of water scarcity and civic push for wider access to (free) water, studies<sup>8</sup> have stressed how domestic wastewater reuse in agriculture could help Europe in tackling water scarcity. Using non-conventional water sources for irrigation purposes (and aquifer recharge) could ensure that a sufficient quantity and high quality of water is reserved for drinking purposes. However, the possibility to resort to this solution at a large scale is currently hampered by barriers which are mainly social and legal. In this article, we briefly outline the current challenges based on existing studies<sup>9</sup> to wonder whether the recent EU legislative intervention on the topic, i.e. the Water Reuse Regulation, is apt to tackle such barriers and how.

Thus, our main research question reads as follows: *how can the new EU Water Reuse Regulation foster public acceptance of non-conventional water reuse practices in agriculture and boost such practices?* Studies on challenges and opportunities of water reuse across Europe are abundant in the grey and academic literature, such as – respectively – the Innovation Deals project<sup>10</sup> and the

6 European Commission, Communication from the Commission: A Blueprint to Safeguard Europe's Water Resources, COM(2012) 673 final, <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0673&from=EN>. Accessed November 1, 2020.

7 European Commission, Communication from the Commission on the European Citizens' Initiative "Water and sanitation are a human right! Water is a public good, not a commodity!", COM(2014)177, <http://ec.europa.eu/transparency/regdoc/rep/1/2014/EN/1-2014-177-EN-F1-1.Pdf>, accessed November 4, 2020; European Citizens' Initiative, Water and sanitation are a human right! Water is a public good, not a commodity, ECI(2012)000003, <http://ec.europa.eu/citizens-initiative/public/initiatives/successful/details/2012/000003>, accessed November 4, 2020.

8 A. Lopez *et al.*, Agricultural wastewater reuse in southern Italy, *Desalination* 2020 (187), p. 323; S. Barbagallo *et al.*, Analysis of treated wastewater reuse potential for irrigation in Sicily, *Water Sci. Technol* 2012(65), p. 2024.

9 Such as IMPEL, Rapporto finale: Riutilizzo delle Acque Urbane, project "Integrated Water Approach and Urban Water Reuse", Version 2.0, 2018.

10 Innovation Deals, Project deliverable 1: Joint study of regulatory barriers to wastewater reuse and their influence on market uptake of innovative technological solutions for waste water treatment. Demonstrated on the example of AnMBR technology, 2018; Project deliverable 2: Options for overcoming regulatory barriers for wastewater reuse. Impacts and consequences on AnMBR technology uptake, 2018.

Suwanu Europe project,<sup>11</sup> and Kamizoulis et al.<sup>12</sup> and Kellis et al.<sup>13</sup> Refraining from replicating existing studies, the original contribution of this piece to the scientific and academic debate is to provide a novel discussion of the transformations triggered by the new EU Regulation. Moreover, we aim at suggesting an innovative avenue to foster public acceptance of wastewater reuse in agriculture based on engaging interested users in water quality monitoring.

We focus on the status quo of the policy and legislative panorama for agricultural water reuse in European and neighbouring countries. Targeting a technical and associated legal innovation in the agricultural sector and the acceptance thereof by stakeholders, we found particularly useful to read the said reality through the ‘neo-institutionalism’ theory, which studies transformations in institutional dynamics and resistance by institutional actors to them.<sup>14</sup> Throughout this lens, we develop a policy and legal analysis adopting a socio-legal approach, that is, we complement the inquiry into the relevant policy and legal aspects with an eye on the social context in which the law is inserted. While concentrating our analysis on the promises and the limits of the new Regulation for stimulating greater water reuse, we also look at a distinctive, complementary solution to foster public acceptance of such an innovation and stimulate trust in the process. We indeed investigate the original avenue of engaging interested and concerned stakeholders in monitoring reused water quality through citizen science projects.

Some caveats must be made. The first clarification is that for European ‘residents’ or ‘users’ we mean *all the population* living in Europe or consuming products farmed in Europe who can be exposed to or benefit from the consequences of domestic wastewater reuse in the European agricultural sector. Second, for ‘water reuse (in agriculture)’ we mean the treatment of (only) *domestic effluents* from urban environments and the use of such reclaimed water for agricultural purposes (e.g. irrigation). As we do not discuss the treatment and reuse

11 SUWANU Europe, Project Deliverable 1.1: Regional state of play analyses. Horizon 2020 – Coordination and Support Action, Coordinated by BIOAZUL, 2019.

12 G. Kamizoulis et al., Wastewater recycling and reuse practices in Mediterranean region: Recommended Guidelines, [http://www.a-angelakis.gr/files/pubrep/recycling\\_med.pdf](http://www.a-angelakis.gr/files/pubrep/recycling_med.pdf). Accessed December 3, 2020.

13 M. Kellis, I.K. Kalavrouziotis & P. Gikas, Review of non-conventional water reuse in the mediterranean countries, focusing on regulations and policies for municipal and industrial applications, *Global NEST Journal* 2013 (15), p. 333.

14 V. Lowndes, The institutional approach, in D. Marsh & G. Stoker (eds.) *Theories and Methods in Political Science*, 2010; V. Lowndes & M. Roberts, *Why institutions matter: the new institutionalism in political science*, 2013; G.L. Rosner, *Identity management policy and unlinkability: a comparative case study of the US and Germany*, Dissertation defended at the University of Nottingham, 2014.

of *industrial water*,<sup>15</sup> the risk of presence of noxious metallic compounds in the effluents to be treated is here disregarded. Rather, the type of wastewater discussed in this article poses a possible hygiene and sanitary risk, due to its microbiological components. Indeed domestic wastewater is composed of water mixed with suspended and dissolved organic and inorganic solids. Among the organic substances, a source of concern for human health is represented by pathogenic micro- and macro-organisms that may be present in the water when *Escherichia coli* (hereinafter *E. coli*) is found, indicating faecal pollution. Moreover, chemicals pollutants from daily use of soaps and detergents are also potentially harmful for the users. Furthermore, also pharmaceutical residues represent a source of concern when reusing wastewater.

In the next section, we start by illustrating the methodology and methods adopted. Subsequently, we open our discussion briefly underlining the potential of water reuse in agriculture, both at the international and at the European level. Lessons of successful water reuse in agriculture are illustrated, and conceivable success factors that may have facilitated these achievements are described. After, the article inspects possible reasons for the unfulfilled potential of the practice in Europe, targeting in particular the divergences among EU MSs' legal frameworks and the socio-legal barriers perceived by stakeholders in the sector. Subsequently, the article moves from the perceived to the *actual barriers* to a wider reuse in Europe, mainly represented by human health risks associated with the practice. In consideration of the (real and perceived) barriers hindering water reuse on a large scale, we assess whether the new EU Regulation will boost the practice both EU-wide and at the national level, by harmonizing MSs' legislation. Lastly, we identify a possible complementary solution in an innovative approach to the problem based on users' (pro)active engagement in water monitoring (e.g. water citizen science) which may facilitate public acceptance. We conclude summarizing the answer to our main research question and provide sparks for future research.

## 2 Methodology and Methods

Our article inspects a rather technical subject but adopting a mainly socio-legal lens of analysis as the main object of study is the *public acceptance* of

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15 However, it should be noted that, in certain scenarios, domestic industrial wastewater may flow into the same stream when collected by the wastewater treatment plant system. In this case, also the presence of metallic compounds in the water and the treatment thereof will have to be considered.

non-conventional water use in agriculture. As we investigate a legal innovation in the field, potentially boosting public acceptance of wastewater reuse, we decided to adopt as overarching theoretical lens the ‘neo-institutionalism’ theory.<sup>16</sup> Neo-institutionalism is a study of institutional dynamics and transformations that is actor-centred and does not only encompass formal institutions but also includes *informal* institutions (such as, in our case, farmers and consumers). This theory situates all these interactions in specific historical and social contexts, and explores them from disciplines such as political science, organizational studies, economics and sociology. Consequently, the theory seems particularly in line with the interdisciplinary breath of our research.

A neo-institutionalism lens may be especially helpful in the context of this study as it tries to explain attitudes favourable to change but also *resistance to change*.<sup>17</sup> Such attitudes may be explained by mechanisms of ‘institutional safeguards’<sup>18</sup> according to which institutions are reluctant to transformations whose benefits are uncertain. Rosner<sup>19</sup> indeed notes that often the biggest challenge to innovation is not technical, but economic and *ultimately social*. Another relevant discussion in the neo-institutionalist literature regards shock-driven institutional changes,<sup>20</sup> which will come back in our analysis when we will describe experiences of successful water reuse pushed by extreme droughts.

Adopting this lens as an overarching theoretical frame, we moved to collect and analyse our data. The methodology adopted for this article’s data collection and analysis includes:

- *Secondary data analysis* of academic studies on water reuse and of grey literature produced by national and international institutions (such as EU studies and consultations; project deliverables and reports), collected using a keywords and thematic search, and through a ‘snow-balling’ approach (i.e. letting one source guide us to another);
- *Textual analysis* of EU and national legislations and regulations, available on national archives and databases; these resources have been selected on the basis of existing studies pinpointing at them and of targeted communications with experts;

16 *Lowndes; Lowndes & Roberts; Rosner, supra* note 14.

17 *Rosner, supra* note 14 at p. 41.

18 *A.J. Meijer*, Trust This Document! ICTs, Authentic Records and Accountability, *Archival Science* 2003(3), p. 275.

19 *Rosner, supra* note 14 at p. 173.

20 *Id.* at p. 61.

- *Sentiment analysis* of primary data, including the response by interested and concerned stakeholders to the consultations launched by the EC in occasion of the release of the EU Proposal for a Regulation on water reuse,<sup>21</sup> adopting the described socio-legal lens of inquiry; the data could be accessed as made publicly available on the EC's webpage.

Considering the scarcity of existing research on the socio-legal aspects of this recent EU legislative development (excluding some relevant studies such as Fielding et al.'s)<sup>22</sup> and the country-specificity of the topic, we decided to complement the literature available with various communications and feedback sessions on the subject with experts in the sector. In particular, we engaged in discussions with experts from the EC Joint Research Centre (JRC) and from a leading water citizen science project. We also participated and interacted with (national) experts in occasion of thematic workshops and conferences, such as the FIT4REUSE Project's Kick-off and subsequent project meetings.<sup>23</sup>

### 3 Investigating the Potential of Water Reuse for Agricultural Purposes

#### 3.1 *State-of-the-Art: Recognized Benefits of the Practice*

From our analysis of academic and grey literature, it resulted that water reuse for agricultural irrigation is increasingly regarded as a valid alternative to the traditional sources of water supply in the sector. Moreover, domestic water reuse techniques have a lower environmental impact than other water supply solutions, such as desalination. Actors and institutions worldwide are calling for adaptive solutions to the current situation of water scarcity, including the United Nations – UN (especially with the Sustainable Development Goal 6 'Ensure access to water and sanitation for all')<sup>24</sup> and the EU (with the Strategic Implementation Plan of the European Innovation Partnership on Water).<sup>25</sup>

21 European Commission, Proposal for a Regulation of the European Parliament and the Council on minimum requirements for water reuse, COM(2018) 337 final, [https://ec.europa.eu/info/law/better-regulation/initiatives/com-2018-337\\_en](https://ec.europa.eu/info/law/better-regulation/initiatives/com-2018-337_en). Accessed November 3, 2020.

22 K.S. Fielding, S. Dolnicar & T. Schultz, Public acceptance of recycled water, *International Journal of Water Resources Development* 2018 (35), p. 1.

23 See <https://fit4reuse.org/>. Accessed October 15, 2020.

24 United Nations, Transforming our world: the 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on 25 September 2015 (2019).

25 The European Innovation Partnership, Water Strategic Implementation Plan, 2012, <http://www.eip-water.eu/sites/default/files/sip.pdf>. Accessed December 1, 2020.



The EC Communication 'Blueprint to safeguard Europe's water resources'<sup>26</sup> inspects the unfulfilled potential of water reuse in the EU, despite the numerous promises of the practice. These promises include: the improvement of the status of the environment both quantitatively and qualitatively; the low financial investment and energy it requires, while contributing to the reduction of greenhouse gas emissions; the reliability of the source, being independent from seasonal drought and weather variability; the richness of reused water which can reduce the need for fertilisers; the potential creation of green jobs.<sup>27</sup> Building on these potential benefits of the practice, this article will reflect on conceivable and actual barriers hindering the potential and adoption of water reuse at a larger scale in Europe, despite the spread of successful examples of reuse around the world, as described in the next section.

### 3.2 *Learning from Examples of Successful Water Reuse around the World*

Water shortage has pushed legislators and regulators in several countries, especially in the Mediterranean, such as in Israel, and on the other side of the Ocean, such as in the U.S. state of California<sup>28</sup> to consider treated water reuse for agricultural purposes as a viable option to reduce fresh water consumption. Interestingly, a study on significance of water reuse across countries around the world<sup>29</sup> shows a still unfulfilled potential for water reuse, yet with a promising increase from 2020, confirmed also by a more recent study<sup>30</sup> outlining developments in wastewater reuse. Discussing estimates from international organizations, Kamizoulis et al.<sup>31</sup> point to the countries with the highest average annual increase in the reused volume of water (up to 25%). In the ranking, we found the U.S., China, Singapore, Japan, Spain, Israel and Australia.

In the U.S., for example, the study reported that California had the largest number of water reuse facilities in the region: around 434 million m<sup>3</sup> of municipal wastewater, of which 68% was dedicated to water reuse for agricultural irrigation. Among the Mediterranean countries, at the time of the study, recycled water in Tunisia accounted for 4.3% of available water resources and was expected to reach 11% in 2030. In Israel, 15% of available water resources was reused in 2000, with a significant pace of increase. This may suggest that *water scarcity* is a key trigger to stimulate acceptance of the practice both by

26 European Commission, *supra* note 6.

27 See <http://ec.europa.eu/environment/water/reuse.htm>. Accessed August 2, 2020.

28 Kamizoulis et al., *supra* note 12.

29 *Id.* at p. 5–6.

30 A.N. Angelakis & S.A. Snyder, *Wastewater Treatment and Reuse: Past, Present, and Future*, *Water* 2015(7), p. 4887.

31 Kamizoulis et al., *supra* note 12.



interested stakeholders such as farmers, and by consumers at large. Especially situations of water stress seem a trigger to overcome the mentioned resistance to changes that is typical of numerous institutions (here understood in a broad sense including farmers and consumers' organizations) and concerned actors. The 'business as usual' model, that is, the reliance on conventional water sources of irrigation, when faced with a (water) shock, has to undergo a transformation. Such shocks can push even the more reluctant actors to accept the practice. However, we deem that the transition to more sustainable sources of irrigation should not (only) be driven by the urgency to reuse.

Actually, for understanding why some countries have been reusing water for agricultural purposes for decades compared to Europe, where the practice is still relatively in its infancy, we need to reflect on the concept of 'innovation'. Experts from Israel from the FIT4REUSE project consortium showed us how using treated water for irrigation is not innovative at all there. On the contrary, it is quite normal, as they have been reusing water for many years, lacking other options than to reuse. In Israel, the need to ensure *food security and independence* from neighbouring countries (local self-sufficiency is also intertwined with national security aspects there) made people accept the use of non-conventional water sources more easily. Only recently climate change-induced droughts pushed several European countries to consider this option as 'vital' to ensure food security, especially for those Mediterranean regions more severely affected by droughts. Framing – and portraying to the eyes of farmers and consumers – water reuse for agriculture as a compelling 'need' or rather as an 'innovation' seems changing substantially stakeholders' attitude towards the practice.

Beyond water stress and self-sufficiency concerns, another important trigger for accepting the practice seems a mere reflection on (economic) *viability* and *convenience*. In a country, such as Europe, where a situation of water stress is less severe than other countries (although increasing drastically in the last years),<sup>32</sup> this type of reasoning can be very convincing for individuals and organizations. A greater reliance on treated water for agricultural irrigation could arguably bring an internal benefit, i.e. stability of the production on the EU internal market despite fluctuation in water availability, thanks to the reliance on a more stable source. Furthermore, it can also bring about an external benefit, i.e. the chance to be competitive on the water market with respect to the techniques that are being developed around the world for wastewater reuse.

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32 See [http://ec.europa.eu/environment/water/quantity/scarcity\\_en](http://ec.europa.eu/environment/water/quantity/scarcity_en); see also European Commission, *supra* note 5.

Experts of the FIT4REUSE consortium from France noted that – especially when crops are particularly vulnerable to water stress and rentable in terms of selling price of their products, such as in the case of vineyards around Montpellier – farmers may be more willing to ‘invest’ in the transition to non-conventional sources of irrigation. This because the losses caused by the scarcity of conventional water sources would be too high. Experts from Greece within the consortium noted that, in case of particularly touristic areas, there might be an additional push to use non-conventional water sources to preserve both farmers and tourists’ interests (i.e. to have water for crops but also have green parks and gardens). Lastly, consortium-affiliated experts from Turkey stressed the potential ‘market strategy’ of branding products irrigated with non-conventional water sources with eco-labels (e.g. branding products as sustainably produced/circular economy friendly) in order to attract new fringes of consumers more environmentally careful.

Arguably, even in scenarios where reusing water would be highly convenient and efficient, a favourable *political will* supporting the idea of reusing is fundamental. The experience of Nosedo Park in Milan,<sup>33</sup> Italy, where the realization of a wastewater treatment plant serving 1,250,000 p.e. was flanked by a related environmental project involving the building of a 100-hectare public park around the plant. The project was strongly driven by a supportive public administration. On the contrary, an adverse political will – as stressed when discussing the neo-institutionalism theory – can slow down or even fully halt a transition to water reuse. Similarly to the national and local level, a strong EU political will in favour of non-conventional water sources for agricultural irrigation, as embodied in the recent EU Water Reuse Regulation, can boost the practice EU-wide and beyond. The Regulation indeed goes in this direction, setting an EU single benchmark for reuse that can harmonize the standards adopted in European MSs and in neighbouring countries, coupled with streamlining the water reuse process at the EU level.

Lastly, the role of technology and the level of *technology advancement* of a specific country seems to matter for water reuse implementation. The regulatory framework also contributes to determine how advanced (or not) is the status of water reuse techniques as they can hinder or rather promote innovation. For example, in Israel – where the practice is particularly advanced – regulations foster *energy efficiency* in the process as they set limits of energy consumption for performing reuse operations. In addition, the reduction of CO<sub>2</sub> emissions associated with water reuse is particularly stimulated by means of regulatory

33 See <http://www.depuratorenosedo.eu/en/parco>. Accessed August 5, 2020.

interventions. Furthermore, Israeli regulations push for faster irrigation rates based on treated wastewater, thus improving the overall *time efficiency* of the process. The aspect of energy and time efficiency (in addition to cost efficiency) suggests that also geographical characteristics of a country are particularly important factors to determine the viability and acceptance of water reuse in agriculture. As a matter of fact, in countries like Greece where water to be treated (urban effluents from the two main cities, Athens and Thessaloniki) is produced very far from those agricultural areas where it is needed, the practice may result in being not particularly efficient in terms of time, costs and energy consumption. Conversely, areas like Italy, where there are many urban areas close to agricultural lands, the process may bring considerable time, cost and energy gains.

In conclusion, we can affirm that a water shock, technology advancement, political will, convenience and efficiency, and numerous other factors are key (complementary) aspects to determine the success or failure of an initiative aimed at (re-)using treated water.

### 3.3 *The Status of Non-Conventional Water Use for Agriculture in Europe*

Within the European region, domestic wastewater reuse in agriculture is performed to a still unsatisfactory level. Only about 1 billion cubic metres is reused annually, amounting for just 2.4% of the treated urban wastewater effluents and for less than 0.5% of the annual EU freshwater withdrawal, whereas the actual potential would amount to around 6 billion cubic metres, *six times* the volume of water currently reused.<sup>34</sup> However, the situation may be reversed with the advent of the new EU Water Reuse Regulation.

The Strategic Implementation Plan of the European Innovation Partnership (EIP)<sup>35</sup> explored the bottlenecks of water reuse in general (not only for agriculture). The EIP Plan categorizes the barriers to reuse as of two natures: *technical* and *socio-legal*. We are particularly interested in the second type of barriers, namely: a scarce institutional capacity to implement reuse measures; a lack of financial and social incentives towards reuse; the existence of a sub-optimal market for wastewater reuse by-products (e.g. the recovered nutrients); and – most importantly – the absence at the EU level of an harmonized regulatory framework and homogenous safety and quality standards for reused water.<sup>36</sup> All these barriers generate or at least augment a certain resistance both from the public and from competent authorities towards the practice. This resistance to innovation, coupled with a (relative) lack of perceived urgency, represents in

34 *Supra* note 3.

35 *Supra* note 25.

36 *Id.* at p. 10.

our view the main obstacle preventing the scaling up of the practice in Europe. We read this obstacle through the neo-institutionalism theory lens, and wonder how this obstacle can be removed.

We explore two possible avenues to tackle the public acceptance barrier. First, we assess the potential of setting *common EU standards* for the use of non-conventional water sources in agriculture in order to remove potential obstacles to the free movement of agricultural products irrigated with reused water (in line with what proposed by the EC Communication 'A Blueprint to safeguard Europe's water resources').<sup>37</sup> Second, we inquire into the implementation of *participation processes* to promote risk awareness and adoption by the public(s) (as suggested by the EIP).<sup>38</sup> We analyse the cited EC Proposal for a regulation setting EU-wide common standards on water reuse and the actual Regulation issued in June 2020 in light of this two-fold perspective.

### 3.4 *Barriers Hindering Public Acceptance of Wastewater Reuse for Agriculture in Europe*

In this section, we use a 'sentiment analysis' approach to inspect specific socio-legal barriers perceived by the European residents in relation to treated water use in agriculture. We use the data from an EU-wide Public Consultation conducted from 30 July until 7 November 2014 summarized in a report titled 'Optimising water reuse in the EU'.<sup>39</sup> In addition, we review the results of an in-depth study into public acceptance by Fielding et al.<sup>40</sup>

Interestingly enough, the responses do not mention as barriers to reuse the stringency of national standards, technical barriers or scientific uncertainties. Mostly, the respondents showed serious concerns for health issues associated with water reuse. However, they were unable to provide evidence of their claims. Furthermore, respondents reported the lack of clarity on the regulations for managing those risks associated with water reuse. Also the fear for potential trade barriers for irrigated products emerged; however, again, no respondent provided any evidence of actual trade barriers. The costs of reusing wastewater was stressed too as posing highly or moderately important barriers. Health concerns, a cumbersome risk management, trade issues and extra costs appeared to be all key sources of public resistance, yet not always grounded in scientific evidence of which the public consulted was aware. Such an outcome

37 European Commission, *supra* note 6 at p.14.

38 EIP, *supra* note 25 at p. 10.

39 BIO by Deloitte, Optimising water reuse in the EU – Public consultation analysis report prepared for the European Commission (DG ENV), 2015, pp. 6, 24–25, [http://ec.europa.eu/environment/water/blueprint/pdf/BIO\\_Water%20Reuse%20Public%20Consultation%20Report\\_Final.pdf](http://ec.europa.eu/environment/water/blueprint/pdf/BIO_Water%20Reuse%20Public%20Consultation%20Report_Final.pdf). Accessed August 25, 2020.

40 Fielding et al., *supra* note 22.

could be associated with the respondents' lack of proper knowledge and understanding on the matter on which they were consulted. Yet, the public consultation was also addressed to experts, and – contrarily to the expectations – the barriers perceived by the experts were not substantially different from those perceived by lay citizens. We thus suggest that – regardless the level of expertise – beyond the 'niche' of those involved, the debate is dominated by a lack of clarity, misunderstandings and scepticism, as also emerged in the survey conducted as part of the AQUAREC project.<sup>41</sup>

On the academic arena, Fielding et al. provided a systematic review of the existing research on public acceptance of recycled water, focusing on socio-legal barriers.<sup>42</sup> The authors reviewed two sets of studies: research into triggering factors for public acceptance of recycled water, including socio-demographic and psychological predictors of acceptance; and experimental or empirical case studies on approaches that have been successful in increasing public acceptance of recycled water. Fielding et al.<sup>43</sup> concluded that the body of literature on the factors associated with public acceptance of reused water is considerable. However, these studies do not target specifically reuse in agriculture. This article responds to the authors' call to fill this gap. The authors also make a case for this paper's analysis of participatory water monitoring. They indeed stress the importance of providing to the public information about the recycling process and other key aspects in order to increase acceptance of the practice, as well as the need of 'policy makers genuinely working through issues *with the public*'<sup>44</sup> [emphasis added]. Here, we interpret public information and engagement extensively exploring water citizen science to foster people's proper understanding of the water (reuse) cycle and its safety mechanisms.<sup>45</sup>

### 3.5 *From Perceived to Actual Risks: Which Public and Occupational Health Concerns the EU Regulation Has to Target*

The EC<sup>46</sup> in its preparatory work towards the EU Water Reuse Regulation draws on the four volumes of the "WHO Guidelines for the safe use of wastewater,

41 AQUAREC, Final Project Report: Integrated Concepts for Reuse of Upgraded non-conventional water. Report n.EVK1-CT-2002-00130, 2006, <http://s3-us-west-2.amazonaws.com/uclid-nuxeo-ref-media/57602a30-7e57-40a7-93f2-fd621d70b7ae>. Accessed November 5, 2020.

42 Fielding et al., *supra* note 22 at p. 2.

43 *Id.* at p. 24.

44 *Id.* at pp. 27, 29.

45 V. Strang, *The Meaning of Water*, 2004.

46 DG ENV & DG JRC, Technical Workshop "Water reuse in agricultural irrigation and aquifer recharge: towards minimum quality requirements at EU level", 25–26 June 2015, <https://circabc.europa.eu/sd/a/41fdc678-d28b-4d74-ae21-e42coe607d3b/A.%20Dalsgaard%20-%20WHO%20guidelines.pdf>. Accessed November 30, 2020.

excreta and greywater in agriculture and aquaculture".<sup>47</sup> With these guidelines, the UN regulator aimed at maximizing the potential of wastewater reuse, while ensuring human health protection, taking a precautionary approach and considering other public health safety standards applicable.<sup>48</sup> The 2006 WHO Guidelines and in particular the sections in each volumes on 'Health-based targets' shaped the EU Regulation. Yet, the standards had to be adapted to the particular EU scenario, taking into account the peculiar European agricultural sector.

Moreover, the acknowledgement of the existence of widespread misunderstandings associated with the reuse of reclaimed water pushed the EC to focus on the *real risks* for public and occupational health in drafting the Regulation. These risks can be identified with the direct and indirect exposure of the public with microbiological agents, metals (such as gold, silver, zinc, iron and sulphur) and anthropogenic contaminants (such as drugs and chemical substances). These risks are difficult to assess as they depend on several variables, such as the origin of wastewater, the conditions of its treatment, its use and the different exposure pathways (e.g. direct ingestion of reclaimed water; simply inhalation of droplets; consumption of food irrigated with reclaimed water etc.). In terms of exposure, according to the 2006 WHO Guidelines, the greatest concern for wastewater reuse in agriculture regards the raw consumption of certain foods that are irrigated with reclaimed water, for example raw eaten crops that grow in the soil (root crops) or close to the soil (leaf crops). However, such risks are uncertain due to the scarcity of health risk quantification and epidemiological studies on the subject.

Also emerging pollutants, deriving for example from the pharmaceutical industry or from personal care and household activities, can have serious long-term effects on human health, despite their minimal presence in domestic effluents. However, also in this case, there is no scientific consensus on the actual risks that could derive from the consumption of crops irrigated with wastewater containing such substances. State-of-the-art secondary treatment of wastewater seems insufficient to remove these pollutants, whereas more advanced and costly treatment technologies may succeed in removing them.

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47 World Health Organization, Guidelines for the safe use of non-conventional water, excreta and greywater in agriculture and aquaculture, Volume 1: Policy and regulatory aspects, 2006, [http://www.who.int/water\\_sanitation\\_health/sanitation-waste/non-conventionalwater/non-conventional-water-guidelines/en/](http://www.who.int/water_sanitation_health/sanitation-waste/non-conventionalwater/non-conventional-water-guidelines/en/). Accessed November 10, 2020.

48 R. Aiello *et al.*, Risk assessment of treated municipal non-conventional water reuse in Sicily, *Water Science and Technology* 2013(67), p. 89.

This suggests that the issue of economic affordability of water treatment technologies should be investigated further.

Another source of concern regards the occupational health risks that may affect the workers exposed to reclaimed water in their daily activities, such as farmers and employees in the reclaimed water industry, and in industries where reclaimed water is used. If, on one side, these workers may be exposed to potential contaminants for longer periods than those consuming products irrigated with wastewater, the risks for them may be mitigated through awareness strategies, a deeper understanding of the risks and the implementation of preventive measures (e.g. protective equipment). The literature, however, does not report cases of occupational diseases caused by exposure to reclaimed water.<sup>49</sup>

The need to overcome this knowledge gap was perceived by the EC, which supported research on the actual risks associated with agricultural wastewater reuse, in preparation of the Regulation of 2020. Among these studies, the EU-funded SAFIR project<sup>50</sup> demonstrated that, at least in the countries studied (Crete, Italy and Serbia), microbiological health risks (mostly deriving from *E. coli* concentration) associated with the ingestion of potatoes and tomatoes harvested with reclaimed water were negligible. Yet, the study noted that farmers could be exposed to higher risks for the accidental ingestion of soil irrigated with treated water. An additional point of concern was related to the potential effects of reclaimed water on the irrigated soil. The SAFIR study found a high *E. coli* concentration in some soil samples irrigated with reclaimed water. However, according to SAFIR's scientists, there may be other causes for these high concentrations, for example bird droppings or previously used manure. Nevertheless, such *E. coli* peaks in the soil studied would make wastewater-based irrigation practices exceed the WHO's limits, so eventual patterns of causality between *E. coli* levels in soil and the water used to irrigate it should be further explored.

Another EU-funded project in the field is the DEMOWARE project.<sup>51</sup> Remarkably, the project targeted barriers to reuse by developing experimental innovations on site to explore public perception of risk. Moreover, we can

49 R.E. Rosenberg Goldstein et al., Occupational Exposure to Staphylococcus aureus and Enterococcus spp. among Spray Irrigation Workers Using Reclaimed Water, *International Journal of Environmental Research and Public Health* 2014(11), p. 4340.

50 SAFIR, Vegetables irrigated with recycled water are safe, FOOD-CT-2005-023168, 2010, [https://www.researchgate.net/profile/Mathias\\_Andersen/publication/312586697\\_Vegetables\\_irrigated\\_with\\_recycled\\_water\\_are\\_safe/links/58838a9a6fdcc6b79107bf6/Vegetables-irrigated-with-recycled-water-are-safe.pdf](https://www.researchgate.net/profile/Mathias_Andersen/publication/312586697_Vegetables_irrigated_with_recycled_water_are_safe/links/58838a9a6fdcc6b79107bf6/Vegetables-irrigated-with-recycled-water-are-safe.pdf), accessed November 14, 2020.

51 See <http://demoware.eu/en/news/results-from-the-eu-consultation>. Accessed August 9, 2020.



mention the Water4Crops venture, one of the largest Euro-India collaborative projects, co-funded by the Department of Biotechnology, Government of India, and the EC, aimed at addressing emerging issues related to biotechnological wastewater treatment and reuse in agriculture. The project's findings on overcoming barriers suggest that Europe should *cooperate with non-EU realities and learn from them*. With this joint venture, among the others, the EC demonstrated that it was looking (also) at non-EU countries' best practices to draft an EU unified framework to reuse. This cross-fertilization approach is found also in two other EU-funded projects, i.e. the mentioned FIT4REUSE project, a PRIMA research and innovation venture on reuse of non-conventional water for irrigation and aquifers recharge in the Mediterranean region,<sup>52</sup> and the MENAWARA project, an research venture aimed at enhancing access to water through the treatment of wastewater to be re-used as complementary irrigation.<sup>53</sup>

### 3.6 *The Input from Experts in the Sector from the JRC and the FIT4REUSE Project*

For sharpening the present analysis, we decided to engage in a number of communications and feedback sessions with experts in the sector (in particular, at the JRC, over spring/summer 2019 and winter 2020) as well as with participation in thematic workshops and conferences (such as the FIT4REUSE Project's Kick-off and annual meeting, which findings are disseminated across the paper).

At the JRC, we had the opportunity to discuss the EU Proposal for a Regulation on minimum requirements for water reuse with experts that have been involved in the drafting process. In particular, we could get precious insights into a key document on which the Proposal has been built, i.e. the Impact Assessment accompanying the Proposal.<sup>54</sup> The Impact Assessment, remarkably for this research, highlights a number of hindrance factors to successful reuse, i.e. the absence of a unified legal framework across the EU and, overall, a trend of interested actors perceiving reuse as more risky than beneficial. The Impact Assessment evaluates strategies to minimize risks, but also how to ensure that resistance from the public is not caused by unfounded,

<sup>52</sup> *Supra* note 23.

<sup>53</sup> See <http://www.enicbcmed.eu/projects/menawara>. Accessed July 25, 2020.

<sup>54</sup> European Commission, Inception Impact Assessment on Minimum quality requirements for reused water in the EU, 2016, [https://ec.europa.eu/smart-regulation/roadmaps/docs/2017\\_env\\_006\\_water\\_reuse\\_instrument\\_en.pdf](https://ec.europa.eu/smart-regulation/roadmaps/docs/2017_env_006_water_reuse_instrument_en.pdf). Accessed November 15, 2020; European Commission, Impact Assessment accompanying the Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for water reuse, SWD(2018) 249 final.

rather than grounded concerns. Indeed, an expert from the JRC noted that key barriers to acceptance are *misperception* and *mistrust*, rather than actual legal or public health barriers; this is why political support, public engagement and effective communication are crucial, as the mentioned experience of the Nosedo Park in Milan shows. There, a sewage treatment plant was realized in a highly participatory manner including the creation of a park open to the public. Furthermore, the expert noted that art and culture can also play an important role in spreading water awareness among citizens, as demonstrated by the initiative of the Urban Water Atlas for Europe and of the 'Water-Energy-Food-Ecosystem Nexus' Atlas for the Mediterranean.<sup>55</sup>

We also engaged in communications with the experts from the JRC team working on citizen science (i.e. the engagement of lay people in scientific research and policy) for environmental policy. It resulted that water-citizen science might play a key role in stimulating public acceptance. Encouraging citizens to participate in water quality monitoring and check 'by themselves' the safety of treated wastewater can substantially remove/mitigate public acceptance barriers. Reflections along these lines are also found in the findings of the pre-study for a World Water Quality Assessment.<sup>56</sup> Yet, the open question is whether citizens can and shall be involved only as data collectors and possibly data interpreters being the data analysis still performed by scientific actors such as the JRC, or if such lay people can also *perform the data analysis* step, if duly instructed and trained.

Lastly, the experts in the sector from the JRC stressed the importance of learning from and building on successful examples of wastewater reuse practices around the world and, especially, of those non-EU countries in the Mediterranean Region. The EC is particularly interested in findings from non-EU countries – especially those neighbouring Europe – and in their implementation of the new EU Regulation (or lack thereof). Experiences such as the FIT4REUSE Project could represent a milestone to achieve a cross-national dialogue targeting real and perceived barriers. Within the project, partners from Italy, Spain, France, Greece, Israel, Tunisia and Turkey are cooperating to provide safe, sustainable and accepted options of water supply for the Mediterranean basin by exploiting non-conventional water resources. Among the other points of action and especially relevant for this article, the project will perform an *holistic assessment* of the practice to improve its public and

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55 See respectively <https://ec.europa.eu/jrc/en/publication/urban-water-atlas-europe> and <https://www.water-energy-food.org/nexus-platform-the-water-energy-food-nexus/>. Accessed December 2, 2020.

56 See <http://www.wwqa-documentation.info/>. Accessed November 3, 2020.

legal acceptance and it will work on the creation of a multi-stakeholder platform to foster dialogue and uptake. Future research should evaluate the benefits and progresses that projects such as FIT4REUSE bring to the sector.

### 3.7 *Analysis of Stakeholders' Attitudes towards the EU Proposal*

We analysed through a 'sentiment analysis' approach the (20) responses<sup>57</sup> that were provided – throughout July and August 2018 – by interested stakeholders (e.g. consumers and farmers' associations; industries; research centres and the public sector) to the feedback request by the EC on the Proposal for a Regulation. We identified a number of recurring clusters of arguments among the responses. First, we noted among the stakeholders that participated to the consultation a widespread concern on a possible *disconnect between the reality and the law*. Another recurring aspect was the need of *coordination with existing national regulations* in order to avoid a cumbersome adaptation.

In line with what suggested by the neo-institutionalism theory, resistance among the respondents was triggered by *envisaged costs* associated with the implementation of the Regulation, and by *concerns for a fair competition* on the water market and for irrigated products. Furthermore, the need of *effective enforcement mechanisms* emerged as a crucial aspect of the implementation process. Also concerns on *different know-hows and preparedness* in different parts of Europe emerged as a factor potentially causing problems in the implementation of the Regulation. On a proactive level, numerous stakeholders advised for *even greater inclusion of the public*, through awareness-raising actions and participatory initiatives. Overall, we noted among the responses an enthusiastic feedback from academia, the market and from the public sector to the proposed EU intervention.

## 4 A Step ahead for Stimulating Public Acceptance of Agricultural Wastewater Reuse?

### 4.1 *Towards an EU Legislative and Regulatory Way Forward*

At the European level, the EC released in June 2018 a Proposal for a Regulation on minimum requirements for water reuse in irrigation and aquifer recharge, towards a 'unified legal instrument on water reuse in Europe'. The Proposal

<sup>57</sup> The responses are accessible on the EC website with the names of the actors that filed them. See [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/1774-Proposal-for-a-Regulation-of-the-European-Parliament-and-of-the-Council-on-minimum-requirements-for-water-reuse/feedback?p\\_id=238837](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/1774-Proposal-for-a-Regulation-of-the-European-Parliament-and-of-the-Council-on-minimum-requirements-for-water-reuse/feedback?p_id=238837). Accessed November 8, 2020.

resulted from the work of the JRC, in consultation with the European Food Safety Agency and with the independent Scientific Committee on Health, Environmental and Emerging Risks. In view of the release of the Proposal, the JRC published in December 2017 an opinion<sup>58</sup> on the discussed legal instrument, recommending the introduction of minimum quality requirements for water reuse in agriculture as a means to achieve a safe and publicly accepted wastewater reuse. According to the JRC,<sup>59</sup> this measure could *stimulate more public confidence in reuse practices* and ensure more certainty and predictability in the EU water sector and market.

The EC Proposal of 2018 has been preceded and shaped by three key initiatives. First, the Impact Assessment Study of 2015,<sup>60</sup> providing the problem definition, an overview of water reuse in the EU and policy options for an initiative by the EC. The study results from a Public Consultation on Policy Options to optimise Water Reuse in the EU of 2014, which showed a widespread consensus on the need to develop minimum quality requirements for water reuse at the EU-level. Second, the Proposal has been inspired by a 2016 Inception Impact Assessment which provided the background to a European initiative in this sense, its policy objectives and options, and its conceivable effects.<sup>61</sup> The assessment has been based on a more recent Public Consultation<sup>62</sup> open to a wide range of stakeholders on Policy Options to optimise Water Reuse in the EU conducted between 2016 and 2017. The third relevant initiative is represented by the Guidelines on Integrating Water Reuse into Water Planning and Management in the context of the Water Framework Directive, developed by the EC, the MSS and interested stakeholders.<sup>63</sup>

58 L. Alcalde-Sanz & B.M. Gawlik, Minimum quality requirements for water reuse in agricultural irrigation and aquifer recharge – Towards a legal instrument on water reuse at EU level, Report n. EUR 28962 EN, 2017.

59 *Id.* at p. 2.

60 BIO by Deloitte, Optimising water reuse in the EU – Final report prepared for the European Commission (DG ENV), Part I, 2015, [http://ec.europa.eu/environment/water/blueprint/pdf/BIO\\_IA%20on%20water%20reuse\\_Final%20Part%20I.pdf](http://ec.europa.eu/environment/water/blueprint/pdf/BIO_IA%20on%20water%20reuse_Final%20Part%20I.pdf), accessed November 15, 2020; BIO by Deloitte, Optimising water reuse in the EU – Final report prepared for the European Commission (DG ENV), Part II, 2015.

61 *Supra* note 53.

62 European Commission, Public consultation on policy options to set minimum quality requirements for reused water in the European Union, 2017, [http://ec.europa.eu/environment/consultations/reused\\_water\\_en.htm](http://ec.europa.eu/environment/consultations/reused_water_en.htm). Accessed November 15, 2020.

63 European Commission, Common Implementation Strategy for the EU Water Framework Directive – Guidelines on Integrating Water Reuse into Water Planning and Management in the context of the Water Framework Directive, 2016, [http://ec.europa.eu/environment/water/pdf/Guidelines\\_on\\_water\\_reuse.pdf](http://ec.europa.eu/environment/water/pdf/Guidelines_on_water_reuse.pdf). Accessed November 4, 2020.

This and the previously mentioned initiatives show *a commitment at the EU level to create a shared consensus* among all stakeholders, including concerned public(s), on what the common standards for wastewater reuse in the EU should be. Interestingly, in the Proposal, it is stressed the importance of transparency and access to water quality information as *a critical step for promoting trust* among users and the general public on the safety of reclaimed water. Moreover, it is noted that, in order to encourage confidence in water reuse, information should be provided to the public (point n. 14). Article 10 of the Proposal stresses again the importance of the information to the public stating that MSs shall ensure that *adequate and up-to-date information on reuse of water* is available online to the public. Furthermore, in accordance with the Aarhus Convention, the concerned public should have access to justice in order to exercise their right to live in a healthy environment (point n. 22), if violated by sub-standard reuse practices and denial of due information. Article 12 formalizes the right to access to justice to be ensured by MSs to interested stakeholders, in order to enable citizens to challenge the substantive or procedural legality of measures related to the implementation of the Regulation. From these points, we can affirm that the here advocated participatory approach, based on public consultations and stakeholders' engagement, seems inspiring the overall EC intervention in the sector. After all, this focus on participation of interested actors is also in line with Article 14 of the Water Framework Directive<sup>64</sup> which requires MSs 'to encourage the active involvement of interested parties' in the implementation of the Directive.

The Proposal effectively responds to some of the concerns outlined in this article, in particular with regards to stimulating public acceptance by harmonization of the legal framework. In the Explanatory Memorandum, it is firstly acknowledged that treated urban wastewater provides a reliable alternative water supply for various purposes, among which agricultural irrigation shows the highest potential. However, it is also confirmed that the uptake of water re-use practices "falls far below its full potential, with practices diverging widely across Member States" (p. 2). As a solution, it is noted that the agreement on minimum requirements could increase public confidence in the practice.

The EC identifies the legal basis for taking action in Article 192(1) of the Treaty on the Functioning of the European Union (aimed to protect and improve human health, resources and the environment) and justifies its action on the principle of subsidiarity (p. 4). Regarding this latter principle, due to the shared

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64 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ L 327, 22.12.2000, pp. 1–73.

competence of the EU with the MSs to regulate environment and health in the field of water, an EU intervention setting minimum requirements for water quality would avoid possible adverse effects deriving from reclaimed water reuse for what regards cross-border matters. These would include contamination of reclaimed water in streams shared among countries and the circulation on the EU territory of agricultural products irrigated with reused water. In addition, it is underlined that the envisaged Regulation would be a proportionate response to the objective of fostering a safe reuse of treated wastewater. A Regulation is considered preferable to another legal instrument because it would be directly applicable to business operators, thus stimulating market uptake, and because it would come into force much faster than any potential future amendments to the Urban Waste Water Treatment Directive<sup>65</sup> (pp. 4–6).

In the Preamble of the Proposal, it is stressed that health standards for agricultural products irrigated with reclaimed water can be guaranteed only if quality requirements for reclaimed water destined for agricultural irrigation do not differ significantly from a MS to another. These requirements are identified in “minimum parameters for reclaimed water and other stricter or additional quality requirements imposed, if necessary, by competent authorities” (point n. 7). It is indeed noted that the provisions of the Regulation are complementary to the requirements of other EU legislation, in particular with regard to possible health and environmental risks (point n. 12). Moreover, by providing for specific monitoring requirements on the quality of reclaimed water that all MSs shall ensure compliance with, the Proposal paves the way to a *unified enforcement framework* in Europe (pp. 10–11). In addition, also penalties (Article 16) are foreseen for the transgressors of the Regulation.

At the technical level, the minimum quality requirements of reclaimed water for agricultural irrigation to which reclamation plant operators in each MS shall comply with are laid down in Section 2 of Annex I (Article 4 of the Regulation). Article 5 interestingly provides for a Water Reuse Risk Management Plan to be undertaken by the reclamation plant operator *in consultation* (also) *with end-users*. In Annex 2, the key risk management tasks are spelled out and it is indicated that it may be necessary to adopt additional or stricter requirements than those specified in Annex I, depending on the outcome of the risk assessment (for example, in case of presence of heavy metals in the water). Overall, the public seems to be at the core of the Regulation, which suggests that such a legal instrument may act as a catalyst for stimulating trust from the users and ultimately enhance public acceptance.

65 Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment, OJ L 135, 30.5.1991, pp. 40–52.



#### 4.2 *The Final EU Water Reuse Regulation*

On June 26, 2020, the EU Regulation 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for urban water reuse (only) in agricultural irrigation entered into force. It will apply from 26 June 2023 for all EU MSs. The Regulation is inserted in the new Circular Economy Action Plan adopted in 2020 by the EC, which entails a series of new regulations to boost circular economy in Europe.

The main milestones that the Regulation sets out can be summarized as follows,<sup>66</sup> as far as relevant to our analysis. First and foremost, the Regulation at Annex I defines *EU minimum water quality requirements* and safety distances for the safe reuse of treated urban wastewaters in agricultural irrigation, also in alignment with WHO recommendations, where available, and other international benchmarks e.g. ISO standards. Moreover, the Regulation indicates also *harmonised minimum monitoring requirements*, e.g. the frequency of monitoring for each quality parameter, and validation monitoring requirements. Lastly, the text includes *risk management provisions* to assess and address potential additional health risks and possible environmental risks at Annex II of the Regulation, responding to stakeholders' concerns about (still unknown) health and environmental risks associated with the process. A study completed in fall 2020 by the FIT4REUSE consortium and led by the University of Bologna, Department of Agricultural and Food Sciences (Deliverable 8.7 – “Inventory of the current legislative and policy frameworks addressing unconventional water resources treatment and application”),<sup>67</sup> explored the extent of the adaptation efforts that will be required by selected EU MSs to comply with the new Regulation.

In certain cases and for certain aspects, the national legislation have been found to fully or mostly overlap with the EU provisions. However, also areas requiring substantial efforts for aligning to the new EU benchmark have been identified. Among these areas, we can mention the definition of the *classes of reclaimed water* which indicate the four categories of reclaimed water quality (A, B, C and D) introduced by the Regulation and the corresponding allowed uses, identified according to crops and irrigation technology. In addition, the criteria according to which the reclaimed water will be considered compliant with the requirements set out in the Regulation (parameters include measurements for Legionella, intestinal nematodes i.e. helminth eggs, *E.coli*, BOD<sub>5</sub>, TSS and turbidity) will demand substantial adaptation in certain MSs. Also the definition and validation of the monitoring process (controls required before

66 See <https://ec.europa.eu/environment/water/reuse>. Accessed July 8, 2020.

67 See <https://fit4reuse.org/about/work-packages/#1568818970646-8867d0ca-6b75>. Accessed December 2, 2020.



the reclamation plant is put into operation, upgraded or modified) will require efforts of alignment by numerous MSs.

These interventions seem overall responding to stakeholders' concerns about discrepancies in MSs' standards that could hamper products' circulation on the European market. Such EU-wide standards also set a benchmark for neighbouring countries interested in trading with EU countries. Importantly, as stressed earlier, as the requirements set 'a minimum', MSs are free to adopt/maintain more stringent standards. One could expect that a 'gold-plating' effect<sup>68</sup> could be triggered, also known as 'super-equivalence', that is, when the national implementation of an EU provision (especially used with regards to directives that require transposition in national legislation) goes *beyond* the minimum needed to comply with it. However, studies<sup>69</sup> also pointed to the scarce effectiveness in terms of ensuring higher environmental protection of the EU approach based on a minimum harmonisation. It thus still remains open the question on whether the new Regulation will be just a starting point for MSs to further promote the practice, stimulating circularity in the water cycle and water savings while insuring health and safety, or if rather MSs will tend to 'stick' to the minimum asked for by the EU to be compliant. The discussion is particularly complex as the minimum at stake here is intended to both stimulate the practice with the environmental benefit of reducing water consumption and depletion of freshwater resources, but also to protect human health.

The Regulation 'package' not only sets minimums, but also strives to *stimulate efficiency* in the process, e.g. allowing that treatment operations and urban wastewater reclamation operations take place in the same physical location; making it possible for the same actor to be both treatment plant operator and reclamation facility operator. This seems reflecting the convenience element as triggering factor of public acceptance. However, one could also envisage that this double role may raise concerns regarding a possible conflict of interests and undermine public acceptance, by reducing the level of trust that users and interested actors could have in a figure with such a key role in the process.

68 *J.H. Jans*, Gold plating of environmental measures?. *Journal for European Environmental & Planning Law* 2009(6), p. 417.

69 *K. De Smedt*, Is Harmonisation Always Effective? The Implementation of the Environmental Liability Directive, *European Energy and Environmental Law Review* 2009(1), p. 2; *L. Squintani*, Beyond Minimum Harmonisation: Gold-Plating and Green-Plating of European Environmental Law, 2019.

A number of other measures introduced by the new Regulation seem responding to stakeholders' quest for a streamlining effect on the governance of the process, including validating the checks and controls. In terms of 'operational' efficiency, for example, the Regulation mandates requirements on how to grant permissions for water reuse processes and facilities, addressing manifested concerns about issues related to permits' denial after the reuse plant was already realized. At a cost-efficiency level, dedicated provisions in the Regulation stimulate interventions for promoting innovative schemes and economic incentives to appropriately take account of the costs of water reuse, in line with what emerged from stakeholders' consultations.

Lastly, for what concerns the aspect of public engagement, the Regulation foresees measures (especially at Articles 10 and 11 on Information to the public) aimed at *ensuring better communication to the general public* (on the process, on compliance checks and on the granting of permits). In addition, it welcomes initiatives to *stimulate transparency about water reuse information*, as a way to stimulate more trust in the process. Furthermore, the text advocates for end-user education and training on water reuse, for implementing and maintaining preventive measures, responding to the identified barrier associated with a limited awareness of potential benefits among stakeholders and the general public. Yet, it is worth reflecting on the more 'passive' nature of these forms of engagement, which seems rather limited to communication and information to the public rather than a commitment from the competent institutions to ensure that interested actors take an active role in the process, for example by participating directly in compliance checks and permits' allocation decisions. Such provisions of the Regulation also refer to the obligations of making environmental information available that MSs have under the Directive 2003/4/EC<sup>70</sup> on the right of access to environmental information in line with the Aarhus Convention.<sup>71</sup> While promoting an accurate and accessible provision of information on the water reuse process to the public, the Regulation however does not explicitly foresee (*pro*)*active* forms of public engagement that go beyond being informed and trained. However, as a 'minimum'-setting tool, each MSs will be free to stimulate and introduce more pervasive forms of participation. In the following section, we advance a suggestion for a distinctive

70 Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC, OJ L 41, 14.2.2003, pp. 26–32.

71 Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (25 June 1998) 38 ILM 517.

type of engagement that, in our view, could boost public acceptance of the practice and thus ultimately promote wastewater reuse.

## 5 Citizen Science for Enhancing Public Acceptance

In recent years, numerous research and innovation efforts have tackled the issue of wastewater reuse. We focus here on a particularly promising field, represented by the engagement of citizens in research on (treated) water quality (water citizen science) and by the use of citizen-operated water monitoring technologies based on sensors combined with advanced data analysis techniques and maps (water citizen sensing). Participatory or even grassroots-driven, sensor-based monitoring practices on specific environmental topics of concern can be considered a sub-set of the broader citizen science phenomenon, and labelled as 'citizen sensing'.<sup>72</sup> The European Research Council-funded project 'Citizen Sense'<sup>73</sup> qualifies citizen sensing as a series of participatory practices, where non-expert users of smartphones and networked devices engage with environmental observation and data collection.

As stressed earlier in this article, these efforts are in line not only with the new Water Reuse Regulation but also with the participation requirements provided for in Article 14 of the Water Framework Directive. Furthermore, both citizen science and sensing bring the promise of facilitating public acceptance of wastewater reuse. Such practices have recently been implemented in combination with users' engagement in order to enhance lay people's understanding of topics that are source of concern for the public or on which conflicts with institutions may arise.<sup>74</sup> Such initiatives have also been considered as a tool for participatory risk-problem-solving.<sup>75</sup> Under this perspective, the use of technology in the hands of concerned individuals can be regarded as a catalyst to foster trust and acceptance of wastewater reuse practices. Among the initiatives that could be beneficial to reassure citizens on the safety of wastewater reuse techniques, we found numerous projects in the U.S. such as the Virginia's Citizen

<sup>72</sup> A. Berti Suman, Challenging risk governance patterns through citizen sensing: the Schiphol Airport case, *International Review of Law, Computers & Technology* 2018(32), p. 155.

<sup>73</sup> Citizen Sense: Investigating Environmental Sensing Technologies and Citizen Engagement, <https://citizensense.net/>. Accessed November 2, 2020.

<sup>74</sup> Berti Suman, *supra* note 71.

<sup>75</sup> A. Berti Suman & M. Van Geenhuizen, Not just noise monitoring: rethinking citizen sensing for risk-related problem-solving, *Journal of Environmental Planning and Management*, 2019.

Water Quality Monitoring Program, the Minnesota Water Quality Monitoring Strategy including citizen monitoring and the Arroyo Seco Water Quality Monitoring Program in Los Angeles County.<sup>76</sup>

Within the context of the EIP, several studies have been conducted by different action groups on effective technologies suitable to 'reassure' the public on the quality of the reclaimed water. Among other initiatives, a noteworthy example is the 'Real Time Water Quality Monitoring (RTWQM)'.<sup>77</sup> The system is based on a series of 'sensors and analysers that can measure water quality parameters (physical, chemical or biological) within a reasonable time and (..) with low maintenance requirements'. It retrieves, transmits, processes and validates raw data, with the aim to transform these data into meaningful information for water managers and interested stakeholders. On the RTWQM webpage, the potential of this monitoring system for providing useful real time information for decision-making is stressed, for example by providing early warnings of detected water pollution. The initiative shows that sensor technologies and data analysis tools can both contribute to ensure water quality by providing means for control and improve acceptance by informing/reassuring concerned actors.

Also in Europe, participatory water monitoring initiatives have flourished in recent years. A noteworthy example is the initiative implemented by the Dutch organization Akvo Foundation, a no-profit devoted to the creation of open source mobile software and sensors aimed at monitoring infrastructure and services, in particular for disadvantaged populations around the world. The organization focuses also on water and agriculture, through its 'Akvo Caddisfly'<sup>78</sup> smartphone-based water quality-testing project. The implementation modality entails a low cost smartphone water testing tool connected to an online data platform ('Akvo Flow'), provided by the organization to interested individuals and communities. Thanks to software applications and hardware attachments, Akvo users can perform reliable tests on water samples and share the resulting data with authorities and interested stakeholders. Results and impacts of the initiative include a scaling-up of the project (Akvo Caddisfly has been tested and is currently used in several countries, ranging from Europe to Asia and Africa), and the agile replication of the Akvo model in different

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76 See respectively <http://deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring/Guidance.aspx>; [http://www.arroyoseco.org/Developing\\_a\\_Citizen\\_Water\\_Quality\\_Monitoring\\_Program\\_for\\_the\\_Arroyo\\_Seco.pdf](http://www.arroyoseco.org/Developing_a_Citizen_Water_Quality_Monitoring_Program_for_the_Arroyo_Seco.pdf); and <https://www.pca.state.mn.us/sites/default/files/lrwq-s-isy11.pdf>. Accessed December 1, 2020.

77 See <https://www.eip-water.eu/RTWQM>. Accessed August 5, 2020.

78 See <http://akvo.org/akvo-caddisfly>. Accessed August 6, 2020.

realities around the world. Furthermore, the project's results have been considered as source of information not only by interested citizens on the ground, but also by competent authorities. Similar projects show that, beside legal and regulatory interventions, a more 'down to earth' work of innovating the water reuse sector can contribute to stimulate public acceptance of the practice. Future research should inspect the potential of this kind of initiatives to foster public acceptance.

As a good example of constructive cooperation between competent institutions and the citizens, a recent project<sup>79</sup> implemented in the Netherlands can be mentioned. The project was launched by the Foundation for Nature and the Environment and supported by the Association of Regional Water Authorities. The water authorities provided citizens with 15,000 toolkits to monitor the water quality in their neighbourhood and thus inform the institutions on the state of the water. One could envisage that similar projects could scale up and expand to also include the monitoring of water quality related to treated wastewater to be reused for agricultural purposes.

Still recently, and more targeted to the matter here discussed, a citizen science project – named 'Off the Roof'<sup>80</sup> – was launched in the U.S. to respond to increasing demands on diminishing water supplies and to the need of relying more on local water supplies. The idea was to use the alternative water source represented by roof runoff for household use, including both potable and non-potable applications. However, there was a lack of data on the potential human health risks of this type of water and which treatment was needed to meet applicable water quality standards. The difficulty to gather data on pathogens in roof runoff (for the rigorous sampling campaign needed, the cross-regional aspects and the overall complexities of measuring human pathogens) motivated the launch of the Off the Roof citizen science project. Overcoming challenges related to recruiting and maintaining committed participants, handling significant weather events and the complex management of the samples' analysis, the project managed to fly, also thanks to the support of the Urban Water Innovation network, of an Environmental Protection Agency's laboratory and of graduate students. Such network enabled the collection of samples from rain barrels by volunteers, delivered thanks to the help of students to the laboratory in charge of the analyses.

In a webinar on 'Implementing a complex citizen science project: Lessons from Off the Roof' on July 23, 2020,<sup>81</sup> we could 'meet' the project founders.

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79 See <https://watermonsters.natuurenmilieu.nl/>. Accessed November 8, 2020.

80 See <https://scistarter.com/project/18259-Off-the-Roof>. Accessed August 1, 2020.

81 See <https://citizenscience.member365.com/public/event/details/52a5d460c34ebf228949942c04905627745e152f>. Accessed September 2, 2020.

Follow-up discussions with them revealed that the team is still in the process of analysing results from the participant survey to evaluate if/to what extent the project increased people's acceptance of this alternative source of water. In terms of eventual influences on policy (e.g. fostering official roof water reuse), we were informed that the intent of the project was to collect data that would ultimately support *development of treatment targets* for using roof runoff. Local competent authorities are exploring how to use the results from the study to inform treatment requirements for roof runoff. As occurred for this project, it is conceivable that – especially in the wake of the new EU Water Reuse Regulation – a citizen science initiative could be launched to explore and foster public acceptance of non-conventional water sources applications in agriculture.

## 6 Conclusions

This article started from the premise that water scarcity, which is becoming ever more pressing also in Europe, pushes European countries to consider the use of non-conventional water sources in agriculture as a valid avenue. We stressed how other countries (especially Mediterranean neighbours) have already implemented adaptive strategies along these lines which turned out to be effective in tackling the problem of water scarcity and saving freshwater resources. Our premise statement includes the argument that adopting water reuse practices can boost water availability within the EU and make EU countries competitive on the water market with respect to the offer of techniques for wastewater reuse. However, we also noted that, despite the widely recognized potential of water reuse, such potential is still unfulfilled due to a number of technical and socio-legal barriers, being they real or only perceived by users (i.e. citizens, farmers and traders) and associated with knowledge gaps and misunderstandings.

This article focused on the second set of barriers and strongly advocated for the adoption of measures to tackle the misperceived risks both at the national and at the EU level. We identified inspiring experiences from non-EU countries similarly facing water scarcity that demonstrate the effectiveness and convenience of treated water reuse for agriculture to reduce fresh water consumption. We pinpointed conceivable and reported factors enhancing a successful implementation of the practice. Nonetheless, we also stressed the importance of paying attention to context-dependence, which inevitably will determine the success or failure of an initiative. Furthermore, it should be noted that our lessons-learning from other countries beyond the EU similarly facing

water scarcity served as a source of inspiration rather than as a benchmark for comparing the EU approach to other legislative and regulatory approaches in non-EU countries. Such a study has been performed in the framework of the FIT4REUSE project (in particular in Deliverable 8.7 – “Inventory of the current legislative and policy frameworks addressing unconventional water resources treatment and application”). Also the work of Mancuso, Lavrnić, and Toscano<sup>82</sup> can be cited in terms of providing a comparative overview of the implementation and regulation of reclaimed water reuse to face agricultural water scarcity in the Mediterranean area.

Here we specifically analysed two avenues to promote wider reuse within the EU, adopting a combination of theoretical and empirical analyses, and taking as reference frame the neo-institutionalism theory. First, in response to the lack of common EU environmental/health standards on the matter and the potential obstacles that could derive for the free movement of agricultural products irrigated with reused water, causing scepticism for the interested public (from experts to laymen), we conclude that the new EU Water Reuse Regulation has the potential to boost the practice. As a matter of fact, at the legal and regulatory level, the release by the EU of a unified legislative instrument setting minimum requirements for water reuse in agriculture is an important step towards the creation of a shared consensus on common standards. Moreover, the Regulation also contains measures to stimulate efficiency in the process, cost-savings and innovation.

Second, at a more applied level, we analysed promising water citizen science initiatives and advocated for the development of participatory water monitoring techniques that could reassure the public on the safety of water reuse. We consider such initiatives valuable both to increase people’s acceptance of alternative water sources, and to support the development of treatment targets and health standards for the safe use of such sources. Especially in the wake of the new EU Water Reuse Regulation, we can imagine that local competent authorities will turn to citizen science initiatives to explore and foster human acceptance of non-conventional water sources in agriculture.

For both lines of action, we stressed that the resorting to participatory elaboration of guidelines, public consultations and inclusion of interested users in monitoring water quality are a precondition for improving public acceptance of wastewater reuse. Indeed, the Regulation itself foresees measures aimed at ensuring more transparency in the communication with the general public,

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82 *Mancuso, Lavrnić & Toscano, supra* footnote 3.



implementing end-user education and training, and stimulating participatory initiatives. Still we noticed that the breadth of public engagement as foreseen by the Regulation is quite limited to a passive involvement based on informing and training stakeholders rather than opening avenues to their (pro)active participation in the process. The new EU regulatory framework thus hints to the role of information and engagement without 'bringing it to a next level' (that we identify in citizen science initiatives). Therefore, we hope that MSs will consider – in aligning national provisions with the Regulation – the EU benchmark as just a minimum to promote more pervasive forms of participation in the process.

Our study is limited in the sense that it does not provide a systematic review of literature on the topic, and a large-scale empirical analysis of stakeholders' responses to the matter. However, it does offer a thorough assessment of two promising avenues to stimulate implementation and public acceptance of non-conventional water sources in agriculture. Considering the topicality of the matter here discussed, we identify the need for future research along the following lines. First, we recommend the gathering of empirical insights into the effects of the recent EU Regulation on public acceptance of treated water reuse in the agricultural sector. In addition, applied research should investigate the influence of public engagement in water quality monitoring on individual and collective trust attitudes towards reuse practices. Lastly, socio-legal lenses of analysis in assessing the benefits and the drawbacks of wastewater reuse deserve further attention, as well as an economic perspective on affordability of reuse practices. By drawing on the complex dynamics and challenges underlying the adoption and acceptance of wastewater reuse in agriculture, we hope to have contributed to the debate and have stimulated constructive reflections.

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