Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Review

COVID-19 water sector responses in Europe: A scoping review of preliminary governmental interventions

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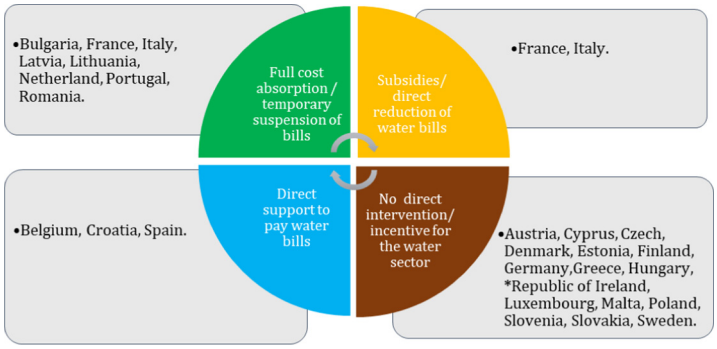
HIGHLIGHTS

- We have examined water related interventions by 27 EU countries during COVID-19 pandemic.
- Identified interventions were predominately short-term measures to ensure uninterrupted water supply and to cushion consumers' losses of income during the pandemic.
- Water can play a significant role in revitalising the economy of Europe post-COVID-19.

GRAPHICAL ABSTRACT



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ABSTRACT

The unprecedented scale and impact of COVID-19 pandemic, and the accompanying lockdown implemented across many countries, has exacerbated water scarcity and security globally. Many European governments have introduced policy interventions to mitigate and protect their economies. Yet, water resources, which are a potential enabler in revitalising Europe's economy, have received few of such policy interventions since the World Health Organization declared the COVID-19 outbreak as a public health emergency only in January 2020. Our scoping review of preliminary government responses of 27 European countries revealed that only 11 (40.7%) of these countries implemented at least one policy intervention that considered the water sector. These interventions were typically short-term measures involving either full cost absorption or deferment of water bills. Much attention on water governance and management processes, policies and financial investments required to augment the resilience of the water sector amid a growing scarcity of freshwater, triggered by extreme climate variation and also by COVID-19 pandemic should therefore be central to post COVID-19 recovery efforts in Europe. This paper also proposes future research directions, including a study that will harmonise water demand and consumption trends during the pandemic in Europe and an assessment on how the water sector can withstand possible external shocks in future.

Contents

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1. Introduction

Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) ordinarily referred to as Coronavirus Disease 2019 (COVID-19) is a pneumonia of unknown aetiology that emerged in Wuhan in the Hubei province of China sometime in December 2019 (Xing et al., 2020; WHO, 2020a). The COVID-19 virus is from the cluster of severe acute respiratory syndrome coronavirus (SARS-CoV/SARS) and Middle East respiratory syndrome coronavirus (MERS-CoV/MERS), which caused two previous coronavirus outbreaks in 2003 (SARS) and 2012 (MERS) (Xing et al., 2020; Wang et al., 2020). By the end of February 2020, COVID-19 had spread from China to other countries. An epidemic curve of COVID-19 cases outside of China as of February 19, 2020, stood at 924 cases in 25 different countries (WHO, 2020b). The impact of the virus and its rate of transmission has since been lethal due to its overwhelming consequences on the social and economic well-being of countries and societies, thereby making COVID-19 far more than a health crisis (UNDP, 2020). As of August 4, 2020, globally recorded cases of COVID-19 were over 18.3 million (ECDC, 2020a; Statista, 2020a). Many countries and economies have also been affected in diverse ways, with approximately 500 million people expected to cross into poverty lines because of the consequences of the virus (Jacobs and Lawson, 2020). In Europe, COVID-19 is regarded as the most significant challenge the continent has ever faced since World War II (Jones et al., 2020).

Although the impact of COVID-19, will be felt differently by countries based on their economic capacity, governance structure and demographic characteristics, since COVID-19 outbreak, there have been numerous health guidelines on how to reduce its transmission which is mainly from respiratory droplets or direct contact with an infected person (UNDP, 2020; WHO, 2020c). Water supply and sanitation have become central in this pursuit as handwashing under running water is a primary approach to mitigating the spread of COVID-19 (WHO, 2020d). However, maintaining hygienic practices, and the mitigation of the COVID-19 pandemic may be challenging especially in places where freshwater sources are scarce (Sustainability Times, 2020). A growing uncertainty thus exists on how water availability and management in various countries can address the challenges of the COVID-19 pandemic since COVID-19 has changed water consumption patterns and also made the impacts of drought and perennial water shortages more acute in countries like Ireland, UK, Turkey, Ethiopia, Kenya, Syria, Poland, Romania, Kosovo and India already suffering from climate variation and continuous decline in rainfall patterns (UfM, 2020; Smart Water Magazine, 2020; Anim and Ofori-Asenso, 2020; Bhowmick, 2020; Cotterill et al., 2020; Irish Water, 2020).

It has been estimated that about 11% of Europe's population is at risk of water scarcity, with an unsafe water supply currently contributing to the death of 14 people every day (UN Water, 2020). Additionally, in Europe 31 million people do not have access to basic sanitation, while about 48 million people do not have even access to piped water in their homes (WHO/Europe, n.d.-a; European Union, 2010). These statistics signify an unsatisfactory level of water resources management and supply in parts of Europe. However, despite the unquestionable importance of the water sector to COVID-19 pandemic mitigation, and the urgency for policy interventions, much of the attention of water-related COVID-19 literature has been focused on tracing COVID-19 in public waterways, particularly relating to wastewater and sewage infrastructure (Ahmed et al., 2020; Haramoto et al., 2020; Hallema et al., 2020; Lodder and Maria de Roda Husman, 2020; Nghiem et al., 2020; Daughton, 2020; Hart and Halden, 2020; Chavarria-Miró et al., 2020). Thus far, scholarly studies on COVID-19 impact and water policy interventions, particularly in Europe, have not received much attention although, water policy measures and interventions are imperative, particularly because clean flowing water is central in promoting hygienic practices towards mitigating COVID-19's spread (WHO, 2020d; Donevska and Panov, 2019; Lobanova et al., 2018; Cisneros et al., 2014). This study, therefore, reviews water sector government interventions in response to COVID-19 in Europe and provides a baseline understanding of the nature of these intervention(s), which subsequently can influence future policies. We focus on two questions: 1) What forms of COVID-19 water sector responses have been taken in Europe? 2) How do these interventions vary between countries?

2. Material and methods

A scoping review is a comparatively new approach in assessing emerging evidence, that relies on a preliminary body of literature to identify knowledge gaps with its essence connected to factors like time and location (Cisneros et al., 2014; Munn et al., 2018). A scoping review method is also beneficial in gathering data in a synthesis approach as research papers on COVID-19 are consistently emerging, particularly on topics that focus on policy reforms and measures in the water sector (Pham et al., 2014; Temple University Libraries, 2020). In this study, 107 relevant works of literature from a series of searches using Google scholar, Scopus, and Web of sciences databases, as well as policy documents from multinational organisations, agencies and accessible databases of various European governments, were considered. Notwithstanding the emphasis on peer-reviewed works from a wide range of sources, there was the consideration of grey literature from websites of companies, government portals and other regulatory bodies to complement published studies on COVID-19, since the body of knowledge on the virus and its impact on the environment, economies and other facets of society are still emerging.

The keywords used in these search were a combination of (Coronavirus disease 2019* OR "COVID-19") AND ("Water resources"* OR "Policy interventions") AND ("Europe" OR "European Union*"). Documents otherwise in English were translated with the aid of google chrome translator extension. A total of 247 documents were initially retrieved with the time scope spanning from February 2020 to June 2020. Titles, keywords, abstract and location restricted to European Union member states were the criteria used in selecting 160 documents for further review (European Union, 2020a). It was revealed that many of the reports carried by websites and blogs were sourced from either press statements or information disseminated by public agencies or institutions like the WHO, EU and their communication units. In order to avoid duplication, the original sources of this information and data were preferred for authenticity purposes. The authenticity test brought the final set of documents to

107 pieces of literature which were found to be relevant to this study. The considered sources were: Google scholar and Scopus databases (23), published documents by EU governments and agencies (39), sustainability/finance/policy/environment based websites (28), multinational organisations/agencies (17).

3. Discussion

3.1. COVID-19 overview in Europe

The impact of COVID-19 in Europe has been enormous, with many countries feeling the brunt of the pandemic when it broke out in February 2020 (CEPR Press, 2020; Taddei, 2020). As of August 4, 2020, 18.3 million cases of COVID-19 including 693,726 deaths and over 11.4 million recoveries had been reported globally of which Europe had a share of over 2,958,340 cases and 205,197 deaths since the first case of COVID-19 related death was reported in France sometime in January 2020 (ECDC, 2020a; ECDC, 2020b; Statista, 2020b). Spain, Italy, UK and France were among countries that recorded the highest number of COVID-19 cases in Europe (Statista, 2020c). The introduction of a restriction on travelling and large meetings, physical distances and lockdowns contributed to a decline in the number of people affected by the COVID-19, nevertheless, April 2020 was Europe's highest peak with COVID-19 cases (Statista, 2020d). On April 4th, 2020 alone, over 40,000 new COVID-19 cases were recorded across Europe (Statista, 2020d).

3.1.1. COVID-19 intervention in Europe

To mitigate the socio-economic impact of COVID- 19, the European Union initiated several interventions, including a €540 billion financial package to support businesses and workers in the EU (Jurišić, 2020). Our scoping review shows that most of these interventions were limited to immediate fiscal impulse, deferrals and liquidity provisions and guarantees. These included deferment of payments like taxes and social security, and credit facilities through national banks for both the public and private sectors. Additional government spending on medical supplies and the health sectors, wages and salaries adjustments were also prevalent among the various measures taken (Deloitte, 2020a; EIB, 2020; European Commission, 2020; Government of Latvia, 2020). These measures are still evolving, with plans underway to develop an European recovery fund which will be closely linked to the upcoming multiannual financial framework for 2021–2027 to deal with the COVID-19 crisis (Federal Ministry Republic of Austria, 2020). Our review indicates that efforts within the EU to address COVID-19 are concentrated on economic recoveries with limited focus on environment resources like water. The limited focus on the environment and its resources may possibly lengthen COVID-19 recovery for countries as economic, social, health, ecological and environmental resource management are interrelated with development (European Commission, 2020; Water Europe, 2020; Anderson et al., 2020; Khalid, 2020).

Although the immediate impact of COVID-19 on the water sector is in its formative stages, its effect on the sector is already manifesting. This is evident from changes in water demand and underlying challenges with water supply. Irish Water- Ireland's national water utility for instance, reported that water usage increased by 24 l per person, per day resulting in 20% increment in overall residential water demand in the Republic of Ireland during the lockdown period from March 2020 to June 2020 (Khalid, 2020; Dwyer, 2020). In the state of Baden-Wurthemberg in Germany, municipal water utility-Stadtwerke Karlsruhe (SWKA) also revealed that variations in water consumption were observed at different times of the day after restrictions were implemented in Germany (WatEner, 2020). The observed changes in consumption patterns were attributed to the closure of schools and non-essential activities, increase in home-working, and other social restrictions introduced by the government. Records from Portsmouth in England also showed a 15% increase in water demand among domestic consumers and a 17% reduction for non-domestic consumers during the peak period of the pandemic (Cooley, 2020).

The variation in water demand among domestic and non-domestic consumers were attributed to the number of consumers who had to stay home due to lockdown restrictions, including smaller businesses that had to operate from homes and restrictions of some site works and operations. As a result, activities like washing, cooking, flushing, handwashing, gardening and filling of pools became prevalent during the implementation of lockdown restrictions, which directly contributed to an increment in domestic water consumption (Cotterill et al., 2020; Cooley, 2020).

Nonetheless, revenue collections for water companies fell by 40% when the pandemic started due to suspension of water charges by some countries or municipalities as a strategy to cushion consumers from the effect of COVID-19 on personal finances (World Bank, 2020). The severity of drought and water shortages, triggered by limited rainfall and increase domestic water demands also raised concerns in places like Ireland and Cyprus and a call for national prayer in Poland for rain (PolandIn, 2020; Luxmoore, 2020; Rakoczy, 2020). Other challenges the water sector had to deal with included the disposal of sanitary consumables such as face masks, medical supplies and other plastic made personal protective equipment, as well as liquid and solid waste management (Kulkarni and Anantharama, 2020; Cheval et al., 2020; Fadare and Okoffo, 2020).

Interruption of operations due to absenteeism, labour cost and procurement of adequate personal protective equipment for staffs and limited supply of essential chemicals for water treatment during the COVID-19 pandemic were other challenges COVID-19 posed to the water sector (European Union, 2010; WHO/Europe, n.d.-b; Pluimers et al., 2013). These challenges are indications that, without a clear sustainability perspective to improving the robustness of water sector, while taking into consideration sanitation and hygiene, as required under financial, institutional, environmental, technical and social sustainability test (FIETS) (Pluimers et al., 2013; Dutch WASH Alliance, n.d.; Şahin, 2020), the water sector may remain in distress should COVID-19 further escalate**.** Nevertheless, these challenges are not limited to Europe alone, but across many parts of the world especially, Africa and Asia, where water scarcity is accelerating due to inadequate investment in the sector, coupled with increasing demand for water and extreme weather variation which impacts available water resources (WHO, 2020c; Bashir et al., 2020; Conseil Superieur des Finances, 2020).

3.2. Country specific water-related intervention

As of June 2020, some European countries had announced measures to support their water sector (Table 1), but while these measures were typically aimed at supporting the payment of water bills and other utilities, there were no major reformation or intervention into the water sector. Although this may be due to differences in water infrastructures and governance structure among countries, aside from the Netherlands and Lithuania, who allowed individual authorities to make their own decisions, only Italy and France had a national directive on water bills with the funding gap supplemented by the government directly.

Among the 27 EU countries assessed, 11 (40.7%) had implemented some water-related measures during the pandemic. These measures were either the temporary suspension of bills or other fiscal interventions such as COVID-19 employment benefits that enabled consumers to pay their utility bills, or a short-term economic relief for consumers' losses of income during the pandemic. However, in comparison with other utilities like electricity and gas, in reference to which some countries have adopted policy measures and actions to guarantee supply, yet a few actions were undertaken on the water sector as seen in the interventions announced by the Cypriots, Maltese, Estonian, Slovakian and Polish government for example.

Table 1
Country-specific water-related interventions in Europe during the COVID-19 pandemic.

	Intervention specific to water	References
Austria	No direct support for the water sector.	(Federal Ministry Republic of Austria, 2020)
Belgium	The government of Belgium undertook a series of social and economic reforms, including a €160 million fund to support technically unemployed persons to pay their utility bills.	(Conseil Superieur des Finances, 2020; KPMG, 2020a)
Bulgaria	Water bill, among other utilities, were suspended under a COVID-19 Emergency Act (COVID-19 Act 2020). The Bulgarian water utility ViK Plovdiv also suspended a €41.9 million water supply and sewage infrastructure upgrade tender due to COVID-19.	(Vlaevsky, 2020; Tanev, 2020)
Croatia	Governmental support and interventions were based on the approval of loans to finance wages, utility cost and working capital with reduced interest rates starting from 0% on loans from Croatian Bank for Reconstruction and Development (HBOR).	(CroatiaWeek, 2020; KPMG, 2020b)
Czech Republic	No direct intervention in the water sector; however, the payment of bills was delayed due to restrictions, which did not allow reading of domestic utility meters.	(Johnston, 2020)
Cyprus	No direct intervention for the water sector, but a reduction of electricity prices by 10% for two months for start-ups existed.	(KPMG, 2020c)
Denmark	No water-related interventions despite numerous fiscal and economic measures introduced by the government.	(IMF, 2020; European Comission, 2020)
Estonia	The entire utility sector was also not considered in a €2 billion relief package announced by the Estonian government.	(Deloitte, 2020b)
Finland	No water-related interventions despite numerous fiscal and economic measures introduced by the government.	(IMF, 2020; European Comission, 2020)
France	A €3 billion financial package towards the social and fiscal cost to utility including deferred payment of water bills.	(Bashir et al., 2020; Deloitte, 2020b; Banque de France, 2020)
Germany	There was no known policy intervention in the water sector. However, the German government during the peak of the COVID-19 pandemic injected funds into climate-friendly mobility or car manufacturing companies, as well as in renewable energy development and energy-efficient buildings.	(Ergebnis Koalitionsausschuss, 2020)
Greece	No direct support for the water sector during the period of the pandemic.	(Ministry of Finance, 2020a)
Hungary	The government cancelled interest on some unpaid taxes and introduced an extension of loan repayment moratorium for households, but there was no direct intervention on water or other utilities.	(Hungarian Banking Association, 2020)
Ireland	No direct support for the water sector during the period of the pandemic.	(Chamber Ireland, 2020)
Italy	A €0.6 billion fiscal package to help reduce utility bills on small production and commercial activities were introduced by the government as well as suspension of water and other utility bills during the peak of the pandemic.	(Water Europe, 2020; Chamber Ireland, 2020; BBC News, 2020)
Latvia	Extension on the payment of utilities including water bills.	(Griffiths, 2020)
Lithuania	Municipalities were encouraged by the government to allow for either instalment basis or reschedule payments for utility bills.	(Government of Lithuania, 2020)
Luxembourg	No direct support for the water sector during the period of the pandemic.	(European Union, 2020b)
Malta	Electricity prices were reduced by 10% but no direct intervention for the water sector.	(KPMG, 2020d)
Netherlands	Over €0.650 billion financial support to the agricultural sector that targeted agricultural-based firms and € 1.5 million loan per company to assist those affected during the pandemic. A temporary extension of payment of bills by regional authorities were also implemented.	(Hungarian Banking Association, 2020; KPMG, 2020d; Netherlands Enterprise Agency, 2020)
Poland	Three-month break for the payment of utilities and credit payment, but emphasis had been on electricity and not water. The special liquidity guarantee fund also made no mention of government intent to suspend or absorb water bills.	(Szepietowski, 2020)
Portugal	A temporary suspension of electricity, water and gas bills.	(Demony and Waldersee, 2020)
Romania	No direct support for the water sector during the period of the pandemic.	(Fair Wear, 2020; Captariu and Graure, 2020)
Spain	A ban on restricting water, electricity and gas supplies to households during the peak of the COVID-19 crises. Under the stability programme of Spain, a €58 million fund to support deferral of expenses for business and self-employed workers and vulnerable households was also announced.	(Reino De España, 2020; F. and F. Ministry of Agriculture, 2020)
Slovakia	No water-related interventions, despite numerous fiscal and economic measures introduced.	(KPMG, 2020e)
Slovenia	No direct support for the water sector during the period of the pandemic.	(IMF, 2020)
Sweden	Financial security and transition opportunities implemented due to COVID-19 but no intervention in the water sector during the pandemic.	(Ministry of Finance, 2020b; Ministry of Enterprise and Innovation, 2020)

Authors construct, 2020.

Although 16 (59.3%) countries were found not to have implemented any water-related intervention during the timeframe of this paper (Fig. 1), due to either difference in water governance and management structures or to peculiar sectorial problems or the resilience of the sector and COVID-19 mitigation strategies, they all had other tailored economic measures in place to cushion their economies (IMF, 2020; OECD, 2020). These individual economic measures to mitigate the overall impact of COVID- 19 may be due to economic forecast that predicts that the EU economy will shrink by 7.75% in 2020 and experience 6.25% drop in 2021 as a result of the pandemic (European Union, 2020c). This means that the economic impact of COVID-19 may be worse than the 2009 financial crises (Smith-Meyer, 2020).

The Republic of Ireland was included in the list of countries with no direct intervention because there already exists a ban on domestic water charges except for excess usage (Government of Ireland, 2017). However, plans to introduce a non-domestic water tariff framework by the Commission for Regulation of Utilities (CRU) was affected. There was also an extension of the public consultation process for Ireland's 3rd River Basin Management Plan due to the COVID-19 pandemic (Catchments News, 2020).

Although these responses and measures taken during the COVID-19 pandemic indicate that water sector challenges and the adaptation and implementation of policy interventions varies among countries, it is still essential to increase attention to the water sector given that water is of significant importance to combating the spread of COVID-19 and for the revitalisation of the economy of Europe post-COVID-19 (Water Europe, 2020). Reforms are needed by countries to ensure, therefore, that their water sector can withstand future pandemics, and also move away from crisis management of water resources to risk management approaches. Reforms such as digitalisation of the water sector, water leakage reduction, citizen engagement and participation in water governance and management as well as water-efficiency in product design and monitoring of emerging pollutants are needed to ensure sustainable growth and development, as part of post-COVID-19 economic

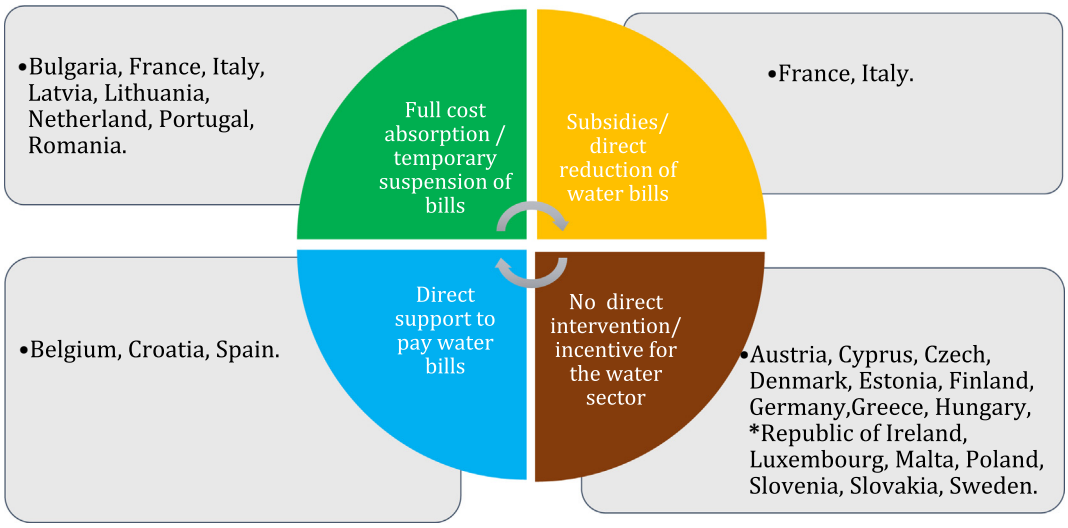

Fig. 1. Summary of immediate water sector responses to COVID-19 in the EU.

recovery efforts in Europe (Water Europe, 2020; Miglietta et al., 2018; Lamb, 2020). Support for gender equality, inclusiveness and human rights and water recycle and use are also among reformations needed (Water Europe, 2020).

4. Conclusion

The revolving nature of COVID-19 makes it difficult to access its actual impact and what the pandemic really means for the water sector. Nevertheless, this review has provided a timely baseline in understanding government responses to the pandemic in Europe. Our review of governmental responses in 27 European countries reveals that COVID-19 pandemic policy measures taken by most European countries centred on fiscal support for the economy, but water which plays a significant role in both socio-economic and well-being had less of direct interventions. Only a handful of countries had water-related interventions predominately consisting of short-term measures to ensure uninterrupted water supply and to cushion consumers' losses of income during the pandemic.

Although, water sector challenges do vary among countries, given the importance of water in combating the spread of COVID-19 and for ecological system efficiency and socio-economic development, there is the need for institutions, governments, non-governmental organisations and stakeholders in the EU to address its impact through an interlinked approach. An interlinked approach is necessary as water consumption patterns between domestic and commercial users are changing amid plummeting water revenues, inadequate investment for infrastructural expansion, coupled with the increasing scarcity of freshwater also becoming a concern in Europe due to factors like extreme climate variation and water leakages. As such, enhance approaches to water governance and management that allows participatory engagements among stakeholders risk management alternatives, water conservation and treatment measures, transparent policy options and the much needed financial investment in the sector should be non-negotiable if the water sector is to withstand a future crisis. Even though we contribute to the existing literature on COVID-19 and its consequences on environmental resources by focusing our attention on water sector policy interventions during the COVID-19 pandemic, this study has some limitation. It was restricted to a specific time frame– February 2020 to June 2020 and only included published and accessible literature on government responses to the pandemic in Europe. Due to the unpredicted nature COVID-19 and its unknown overall impact, the majority of studies emphasises on understanding the nature of the virus, its sources of transmission, presences in waterways and potential vaccines. Only shreds of literature have examined COVID-19 environmental policy interventions and their influence on post-COVID- 19 health, ecological and economic recovery for countries. A study that will harmonise water demand and consumption trends during the pandemic in Europe, as well as how water utilities communicated water conservation and quality measures to consumers during the period of the COVID-19 pandemic and an assessment of how the water sector in Europe can withstand external shocks in future are identified knowledge gaps that need to be explored. Closing these gaps will further advance the path towards achieving the Sustainable Development Goals while influencing policy directions and governance processes for a sustainable and resilient water sector in post-COVID-19 Europe.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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CRediT authorship contribution statement

Conceptualisation: SHA. Writing – original draft: SHA. Supervision: AR, SL, DG. Validation: AR, SL, DG. Writing – review & editing: SHA, AR, SL, DG. Funding acquisition: AR, SL, DG.

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