European Journal of Sustainable Development Research
2024, 8(2), em0251
e-ISSN: 2542-4742
https://www.ejosdr.com/

MODESTUM

Review Article **OPEN ACCESS**

Greece's current water and wastewater regulations and the risks they pose to environmental hygiene and public health, as recommended by the European Union Commission

Ioannis Pantelis Adamopoulos [1,2,3*], Niki Fotios Syrou [4], Jovanna Pantelis Adamopoulou [5]

[1] Region of Attica, Department of Environmental Hygiene and Sanitarian Public Health Inspections, South Sector of Athens, Athens, GREECE
[2] Department of Health Sciences, School of Medicine, European University Cyprus, Nicosia, CYPRUS
[3] Research Center of Excellence in Risk & Decision Sciences, School of Sciences, European University Cyprus, Nicosia, CYPRUS
[4] Department of Physical Education and Sport Science, University of Thessaly, Karies, Trikala, GREECE
[5] Region of Attica, Department of Environmental Hygiene and Public Health Inspections, West Sector of Athens, Athens, GREECE
***Corresponding Author:** adamopoul@gmail.com

Citation: Adamopoulos, I. P., Syrou, N. F., & Adamopoulou, J. P. (2024). Greece's current water and wastewater regulations and the risks they pose to environmental hygiene and public health, as recommended by the European Union Commission. *European Journal of Sustainable Development Research, 8*(2), em0251. https://doi.org/10.29333/ejosdr/14301

ARTICLE INFO

Received: 07 Dec. 2023
Accepted: 16 Feb. 2024

ABSTRACT

To address emerging environmental issues, the European Union (EU) regularly updates its directives and regulations in the areas of wastewater treatment, water reuse, and water quality. The plan specifies standards for safe water reuse as well as quality requirements for treated wastewater. Legislation and regulations in Greece pertaining to wastewater management and water reuse assess how well-functioning current methods are at maintaining water quality, cutting pollution, and protecting public health. Analyze any unique challenges or successes in putting current laws into effect and keeping them in place. Determine areas of agreement and disagreement between EU plan and Greek legislation. EU proposal's possible effects on Greece's infrastructure, adoption of new technologies, and financial implications. This study is a perspective qualitative analysis. Selection of legislation, outline the criteria used for selecting the relevant legislation from EU and Greece. Data sources from obtained the legislation texts. Official government documents, legal databases, and reputable sources. Data variables extracted from the legislation, focusing on aspects related to environmental hygiene and public health risks. Comparative framework used to compare EU commission proposal with existing legislation in Greece. Evaluate the environmental hazards and problems associated with present wastewater management practices in Greece in terms of their potential influence on water quality, ecosystems, public health, and promote environmental hygiene.

Keywords: environmental hygiene, public health, risks, legislation, wastewater, water reuse, European Union

INTRODUCTION

It is important to recognize that treated wastewater is a resource, which the resource has value, and this value will reflect the value placed in the resource. As an economic commodity, properly treated wastewater has value for those who produce it and for those who consume it. This assessment could help provide cost-effective management of wastewater collection and treatment services, with consequent advantages in terms of effectiveness and efficiency of the entire value chain (Garcia & Pargament, 2015). It is crucial to understand that treated wastewater is a resource with value that is determined by the importance of the resource. Reusing water has several possible financial advantages. Water reuse, for instance, can lower the overall cost of implementing the program of measures, as demonstrated by Spain's experience implementing the water framework directive (WFD) (del Tánago et al., 2012).

Financial segments that are exceedingly subordinate on water supply (accessibility and quality), such as horticulture, the nourishment industry, tourism and the relaxation industry, seem increment the security of water supply by reusing water (depending on hydrological prerequisites in a bowl), diminishing their defenselessness to water shortage and dry season as well as their defenselessness to long-term climate alter. This seems bring financial benefits to the businesses concerned. The supply to clients of treated wastewater is restricted but unsurprising. Inside the agrarian division, in spite of the fact that the water required for rural generation has for the most part diminished in most part states taking after the change of the common agrarian approach and the appropriation of more productive water system strategies, in later a long time there has been an increment in water system request in numerous southern and eastern part states (Interwies & Görlitz, 2012). Expanding water shortage, such as climate alter, as well as administrative changes inside the World Health Organization (WHO, 2006), the fetched of securing a new water supply is likely to extend for rural commerce. Vital financial benefits of water reuse for the rural division since treated wastewater treatment is dependable, indeed amid dry seasons (Jaramillo & Restrepo, 2017).

Water that does not contain a great mineralogical adjust may have impediments for a few sorts of rural generation (Reznik et al., 2017). Island locales with water deficiencies (for case, numerous Greek islands and Cyprus) utilize treated wastewater for water system (Salgot et al., 2012). The European Union (EU) water division might advantage financially by growing water reuse, due to commerce openings in this division (European Water Resources, 2020), with water reuse innovations for assist development, and there's a developing worldwide showcase for such innovations (Smol et al., 2020). The nature of any reserve funds for utilities will to a great extent depend on the particular charge, tax collection, etc., wastewater collection and treatment frameworks in each nation (Smol et al., 2020).

Financing of re-use, ventures to bolster treatment ventures, water dissemination frameworks and certain employments such as water system frameworks, these must be taken under consideration within the financial case for reuse of each person circumstance. Capital and operational, costs of exchanging from a freshwater source to a treated wastewater source got to be caught on and neighborhood openings to limit costs and benefits and amplified. Impacts on arrive water reuse for water system can also positively influence arrive possession costs. Positive impacts allude to dry and semi-arid regions, where urban water system may be a key figure in scene greening, clean disintegration and control, and natural assurance. Water reuse can give encourage financial security in a number of divisions, which interprets into social benefits (European Commission, 2012), as long as water reuse does not occupy people's consideration. Decision-makers in water-scarce ranges from moving towards more water-efficient social orders and tending to wellbeing and natural dangers (Garcia & Pargament, 2015).

In Spain, the reuse of water for water system of rural arrive has driven to expanded trim generation and in this way gives one million hours of work amid the gather season (Thomas & Durham, 2003). In southern European Part States tourism is a critical financial division, making a critical commitment to the economy and work. In these water-scarce nations, a solid arrangement of water administrations can back tourism exercises (Green et al., 2011). Water reuse has a roundabout impact on the advancement of tourism, permitting the advancement of water-related exercises and in this way making employments. Reuse and improved health, well-being, and quality of life enable parks and sports facilities to maintain their beautiful landscapes while also enhancing the urban environment. By providing more access to sanitary facilities and clean water, rural communities can attain the sustainable development goals while also protecting the environment by utilizing the right technological solutions.

METHODOLOGY MATERIALS & STUDY DESIGN

Objective the state of the primary goal of study, 1st comparing EU commission proposal with existing legislation on wastewater and water reuse in Greece, 2nd focusing on environmental hygiene and public health risks. Scope is he geographical and temporal scope of study is EU legislations, regulations, rules and studies, and Greece as focus areas. Research hypotheses improve the enhance the current Laws and offer a thorough analysis of the current wastewater and water reuse laws in Greece and EU, with an emphasis on public health and environmental hygiene. European Commission's proposal and the country's current wastewater and water reuse laws protect public health and environmental hygiene by reducing or eliminating risks for EU citizens. Review of identification of gaps and issues in the current legislation that justifies the need for your comparative analysis, and also national and international reports and articles from database (Direct Science, Google Scholar, Medline, PubMed, Scopus, etc.). **Figure 1** shows the flow diagram of the study.

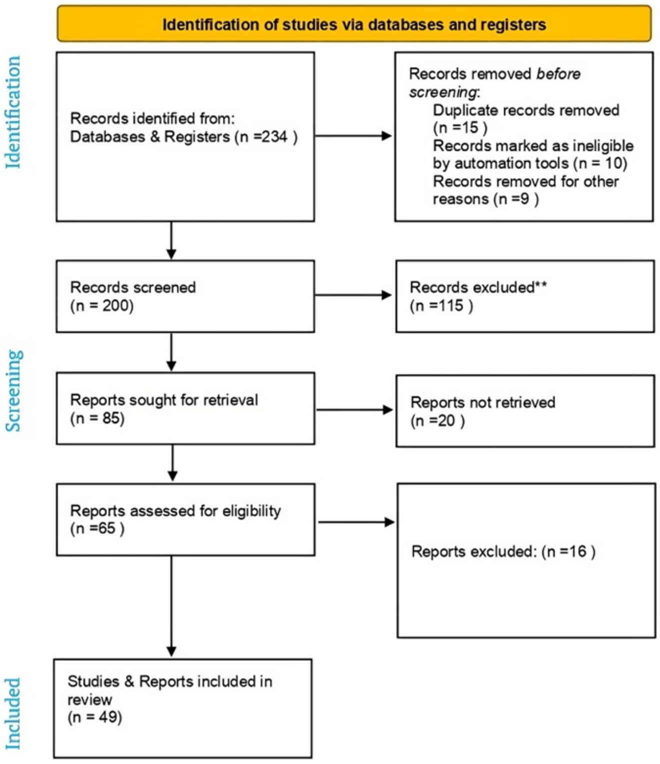

Figure 1. PRISMA flow diagram of the study: Identification of studies via databases & registers of environmental hygiene & public health risks (Source: Authors' own elaboration)

LAWS & DIRECTIVES

European Legislation

The guidelines aim to investigate how reusing wastewater can help achieve goals and how to reduce the risks associated with reusing water to achieve these goals. In order to ensure that reuse systems do not produce outcomes that could conflict with requirements (EUR-Lex-32000L0060-EN-EUR-

Lex, 2020), which include targets for both water quality and quantity, this analysis highlights specific information that water managers need to be aware of. The requirements concern the ecological and chemical status of surface water bodies. It is significant to highlight two aspects of the sequence of factors that establish surface water body status:

(a) the chemistry of recycled water and

(b) the effect of recycling on the quantitative features of the water body.

Article 10 of the EUR-Lex-32000L0060-EN-EUR-Lex (2020) apply the principle of the "combined approach" to the necessary levels of treatment to achieve specific environmental objectives. Furthermore, in order to minimize the degree of treatment needed during the production of drinking water; the article 7 mandates that member states guarantee the essential protection for bodies of water that serve as sources of that water's quality. The regulations pertaining to drinking water protected areas are evidently more stringent and require higher standards of protection (EUR-Lex-32000L0060-EN-EUR-Lex, 2020). Groundwater chemistry and quantitative characteristics may be impacted by the goals, which are related to chemical and quantitative status and are necessary to maintain good status and prevent status deterioration. As an additional measure to support the objectives, member states of EU may repurpose treated wastewater by replenishing aquifers by offering (EUR-Lex-32000L0060-EN-EUR-Lex, 2020). In order to protect groundwater in the EU, certain steps must be taken to prevent or limit the input of pollutants into groundwater, as well as requirements for assessing status, obligations for measures, protection of drinking water, integration with protected areas, chemical status, and identification of significant and sustained upward trends (Directive 2006/118/EC, 2006). Wastewater covered by the waste framework directive 2008/98/EC, since article 2(a) of that directive's exclusion from waste legislation is not a hard-and-fast rule. Therefore, it is crucial that prior authorization regulations (Directive 91/271/EEC, 1991) suitably account for discharges from IPO installations meant for repurposing. The first thing to remember is that treated wastewater. Member states should reduce the amount of harm that recycled wastewater causes to the environment. It should be noted that while the final point in Article 12.1 addresses all negative environmental impacts, many of the direct obligations of EU legislation covered in these guidelines relate to EU water objectives. For instance, according to Directive 91/271/EEC (1991), risks to soil, surface water, and groundwater must be minimized if the reuse of wastewater poses a substantial risk. Article 3 of EPBD lays out member states' responsibilities for collecting wastewater based on the size of agglomerations. It should be mentioned that the requirements for wastewater collection are minimal. Member states have complete freedom to gather wastewater from agglomerations smaller. In places, where water is scarce, such collection could be done to gather water for later use. Accordingly, decisions about the reuse of wastewater are neither restricted nor influenced and requirements for wastewater collection. Reusable wastewater treatment plant water is deemed a discharge at the point of discharge (after treatment) from the water treatment plant. This includes guidelines for secondary treatment, more intensive treatment (nutrient removal), and compliance with other directives' requirements (Directive 91/271/EEC, 1991). EU regulations govern the reuse of wastewater, focusing on water quality and quantity targets. EU WFD protects water bodies, while urban wastewater treatment directive sets standards for urban wastewater collection, treatment, and discharge. Drinking water directive sets quality standards for drinking water, indirectly ensuring water sources' quality. EU water reuse regulation 2020/741 addresses reuse of treated urban wastewater in agriculture, contributing to the circular economy and water sustainability.

Legislation in Greece

Greece experiences varying degrees of water scarcity on its soils, with some of the river basin districts having some of the rarest waters in EU. Greece also experiences less water pressure than other Mediterranean countries, with a water exploitation index of about 14.0% (Eurostat, 2018). Furthermore, as a result of increased demand from the agriculture and tourism industries, two of the main drivers of the nation's economy, water pressure is also higher in the second and third quarters of the year (Amec Foster Wheeler Environment, 2016). Reclaimed water can be used to irrigate a range of crops, including trees, grasslands, and food crops for human consumption, provided that quality standards for water reuse are met (Population.un.org, 2019). Many parameters have limit values, and some of them have extremely strict requirements (Amec Foster Wheeler Environment, 2016). Greek law covers more uses, reclaimed water categories, and control parameters than the Commission's proposal for a regulation on water reuse. There are differences in the scope and frequency of monitoring, and there are no explicit provisions in the national framework for risk management plan development, validation monitoring, or public information dissemination (European Authority Legislations, 2011). The user or the reclaimed water management authority must request the reuse of liquid wastewater from the capable water department of the decentralized administration. In order to achieve the environmental objectives. Considering the unique circumstances of the area in this case. According to GENERATION 2.0 RED (2020) and Prochaska and Zouboulis (2020), further information might be needed to guarantee the safety of the aquatic recipient. Article 13 of joint ministerial decree 145116/11 states that the decentralized water management directorate, in collaboration with the appropriate agencies, conducts routine and ad hoc inspections to confirm adherence to the permit's terms and conditions regarding the reuse of treated wastewater (GENERATION 2.0 RED, 2020; Prochaska & Zouboulis, 2020). Penalties apply when a natural or legal person violates the laws regarding the reuse of water through their actions or inactions. According to GENERATION 2.0 RED (2020) and Prochaska and Zouboulis (2020), decentralized directorate of water management is the competent authority for the purpose of coordinating and implementing the use of recycled water. The key points and distinctions between the European Commission's (2012) proposal and the country's legal framework are summarized in **Table 1**. The main wastewater reuse projects in Greece are shown in **Table 1**, along with the variations in the national legal framework and committee capacity proposal.

Table 1. Comparison of provisions between the Commission proposal & existing legislation on water reuse in Greece

Current legislation	Differences between national legal framework & proposal for a committee
1. Authorizations & responsibilities	
Principles: Required authorizations	A relevant regulation already exists: Reuse permits for treated wastewater can be obtained from appropriate decentralized water management directorate or recovery management authority water.
2a. Definition of measures, terms, & procedures for reuse: Ministerial decision (145116/2011-Government Gazette, 354/B/8-3-2011, 2011)	Water from decentralized water management directorate that is applicable. Application must be supported by an analysis of its operation & design, as well as an activity that complies with pertinent environmental requirements outlined in applicable laws. Regular & ad hoc inspections are conducted by decentralized directorate of water management in collaboration with appropriate agencies to confirm adherence to license's terms & conditions. Proposal only addresses a subset of uses covered by national legislation, which also includes recreational, urban (such as street cleaning & firefighting), environmental (such as environmental restoration), industrial (such as cooling & boiler water recharge), & agricultural irrigation (including woodland).
191002/Government Gazette, B/2220/09.09.2013, 2013)	Similar categories examined include, according to crops & irrigation methods, national legislation covers two categories of reclaimed water for agricultural irrigation (there is also a category for urban uses). But stillIt includes meadows, trees, & vineyards as well.
2c. Requirements for reclaimed water for legionella, intestinal nematodes (eggs helminths), E. coli, BOD5, TSS, turbidity (Official Journal of European Union, 2020)	Several parameters are covered: National legislation has set requirements for a large number of parameters (65 parameters are monitored) depending on category of water reuse. This comprises some of parameters (turbidity, BOD, TSS, & E. coli) that are discussed in proposal as well some additional parameters (pH, EC, heavy metals & metalloids, chlorides, nitrogen, & phosphorus). Various standards for monitoring: Frequency of monitoring is contingent upon water reuse class, with parameters ranging from once or twice a week to every one to two weeks. Greek law mandates more frequent monitoring of E. coli (up to four times per week) for parameters covered by proposal, but less frequent monitoring of other parameters. More details are included in proposal: There were no provisions in Greek legislation regarding validation monitoring within context of proposal. To ensure that design, construction, & operation of this facility comply with submitted study & are compatible with any approved environmental conditions of activity in question, decentralized water management directorate & other competent authorities must conduct an inspection prior to issuing reuse permit. More details are included in proposal: Greek legislation did not contain any provisions for risk management plans. Suggestion is more precise: Greek law lacked specifics regarding disclosure of information to public.
2d. Monitoring requirements: From once a week to twice a month, depending on parameter & category of reclaimed water (Directives 2015/1787/EU & 2013/51/EURATOM, 2016)	
2e. Validation monitoring required before reclamation plant is put into operation, upgraded, or modified (Minimum Requirements for Water Reuse, 2019)	
3. Water Reuse Risk Management Plan (Minimum Requirements for Water Reuse, 2019)	
4. Public information (European Parliament, 2018)	

The Greek legislation and the European Commission's (2012) proposal on water reuse face challenges such as stringency of standards, health and environmental protection, enforcement mechanisms, national context, administrative and institutional frameworks, public perception and stakeholder involvement, and technology and infrastructure considerations. Greece adopts more stringent standards based on regional or national considerations, while the European Commission's (2012) proposal emphasizes public health and environmental protection. Greece's unique geographic and hydrological conditions, administrative and institutional frameworks, and public perception and stakeholder involvement influence water reuse initiatives. Understanding differences is crucial for successful water reuse initiatives.

Differences between the Greek legislation on water reuse & the European Commission's proposals

The Greek legislation on water reuse and the European Commission's (2012) proposals highlight the differences between the two legislations and regulations. These differences include the stringency of water quality standards, the emphasis on public health and environmental protection, and the enforcement mechanisms. Greece's unique geographic and hydrological conditions, administrative and institutional frameworks, public perception and stakeholder involvement, and technology and infrastructure considerations also play a role. To understand these differences, it is recommended to review legal documents, policy statements, and official communications from both governments and consult with relevant authorities and experts in water management in Greece. Consultations with relevant authorities can provide valuable insights into the specific nuances of the national approach.

Research studies of Greece

Greece's, and Mediterranean climate has wet winters and dry summers, with an average rainfall of 874 mm/year. The country faces high rainfall imbalances, causing increased water needs for irrigation and tourism. Annual rainfall ranges from 300-500 mm in southeastern Greece to over 2,000 mm in mountainous areas. Wastewater is considered an alternative water resource (Kalavrouziotis et al., 2015). Greece has significant potential for reusing treated wastewater for crop and landscape irrigation. With over 75.0% of the population connected to municipal effluent treatment plants (MELs), over 83.0% of treated wastewater is produced in areas with negative water balance (Chartzoulakis et al., 2001). Greece must comply with EU urban wastewater treatment directive, with a majority of the population living in settlements over 150,00 (Directive 91/271/EEC, 1991). Activated sludge systems, which consist of extended aeration, conventional systems, and SBR, are the dominant system.

Table 2. Significant wastewater reuse sites capacity of MELs (adapted from Panoras et al., 2011; Paranychianakis et al., 2009; Sbirilis & Kanaris, 2002)

Project	Region	Range (m^3/day)	Irrigated area	Crops
Irrigation of agricultural land				
Thessaloniki (Sindos)	Central Macedonia	165,000	2,500	Corns, sugar beets, rice, etc.
Heraklion	Crete	9,500	570	Grapes & olives
Livadia	Central Greece	3,500		Cotton, corns
Amfissa	Central Greece	400		Olives
Nea Kallikratia	Central Macedonia	800	150	Olives
Peninsula	Crete	4,500	270	Olives
Malia	Crete	2,500	150	
Acharnes	Crete	550	33	Grapes & olives
Kos	North Aegean	3,500	210	Olives, citrus fruits, etc.
Other		10,000		Diverse
Irrigation of other land (parks, forest, etc.)				
Chalcis	Central Greece	4,000	50	
Peninsula	Crete	500	8	
Agios Konstantinos	North Aegean	200	10	
Kentarhos	North Aegean	100	5	
Kos	North Aegean	500	10	
Karistos	North Aegean	1,450	30	
Ierissos	South Aegean	1,500	25	
Other		2,000		
Indirect reuse				
Larisa	Thessaly	25,000		Cotton, corns, etc.
Karditsa	Thessaly	15,000		Cotton, corns, etc.
Lamia	Central Greece	15,000		Cotton, olives, corns, etc.
Tripoli	Peloponnese	18,000		
Other		35,000		
Total		318,500		

Initially, wastewater was disposed of or reused according to other countries' regulations, but water recycling is increasingly being adopted for crop, forest, or landscape irrigation (Tsagarakis et al., 2004). The performance of MELs in Greece has been evaluated, with 42.0% performing well, 41.0% moderately, and 17.0% poorly. The study found a positive correlation between the size of MELs and the quality of outputs. Most MELs comply with Directive EC 91/271 on wastewater generated, but some have higher BOD5 values due to poor ventilation or overload. Some MELs have increased salt levels, suggesting appropriate management practices for agricultural reuse (Andreadakis et al., 2003; Tzanakakis et al., 2014). Wastewater reuse is an old practice in Greece, with a long history of reuse dating back to ancient civilizations. Reusing wastewater from existing MELs can save 3.2%of the total water used for irrigation. However, the potential for reuse in Greece is limited due to the location of the treatment plant and cost of transporting treated wastewater (Paranychianakis et al., 2009). Farmers in important agricultural areas near MELs are willing to use treated wastewater in their fields.

Table 2 presents the major wastewater reuse projects in Greece, together with the capacity of MELs, irrigated areas and main crops irrigated with recycled water (Ilias et al., 2014). The concentration of trace elements in soil and plant tissues was quite low compared to international criteria. Statistically significant differences in yield and cotton seed fluff were observed between treated wastewater and control water. Wastewater resulted in higher yield than freshwater. There were no significant differences in cotton quality characteristics between the two water quality treatments. The statistical analysis showed that no significant differences were observed in relation to corn yield between the two quality waters.

Figure 2, **Figure 3**, and **Table 2** presents the major wastewater reuse projects in Greece, together with the capacity of MELs, irrigated areas and main crops irrigated with recycled water.

The use of treated wastewater in Thessaloniki, treated with activated sludge and chlorination, does not pose a significant health risk due to the presence of pathogenic microorganisms. To mitigate health risks associated with treated wastewater in Thessaloniki, consult local health authorities, environmental agencies, academic research, international organizations, and local legislation and regulations provide the referred recent academic studies, and consult experts in the field. Also the current state of knowledge on health risks associated with treated wastewater and the measures in place to mitigate these risks by reviewing recent publications and official statements from relevant authorities (Angelakis et al., 2005). The groove with blocked ends and drip irrigation system effectively protect farmers from water contact. However, strict health regulations are necessary due to potential health risks associated with treated wastewater.

To mitigate risks associated with wastewater reuse in Thessaloniki, consult local health authorities, environmental agencies, academic research, international organizations, and local legislation and regulations (Koutsoyiannis et al., 2008). The reports from local health authorities, consult environmental agencies, and consult academic research for insights also the guidelines from international organizations, review national and local legislation, and consult experts in the field for specific contexts (Pragya et al., 2020).

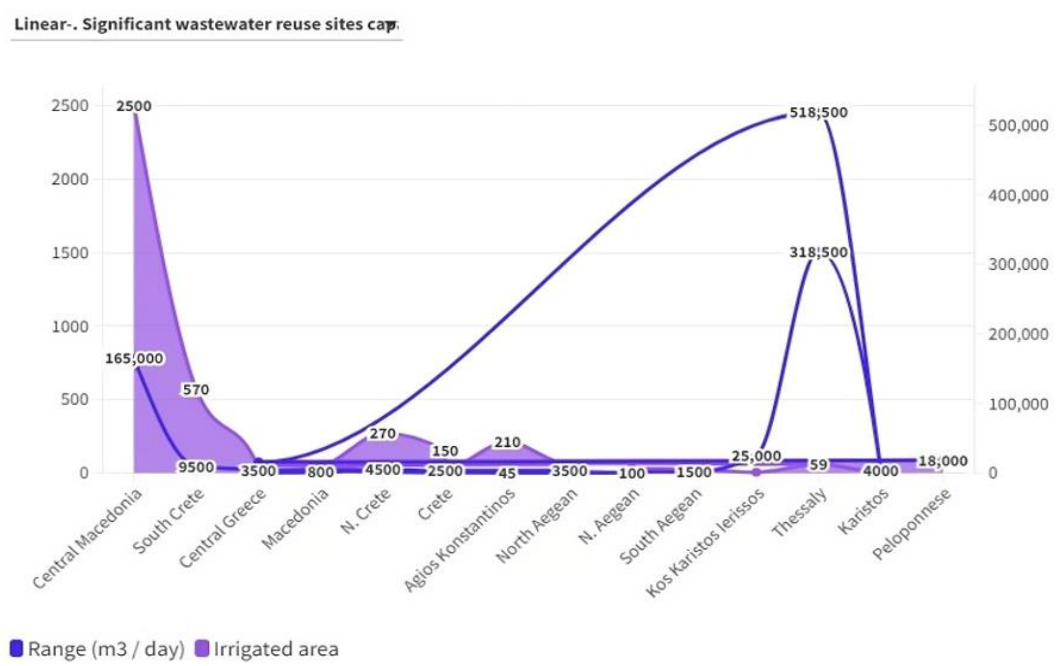

Figure 2. Significant wastewater reuse sites capacity of MELs (per range: m^3/day correlated Irrigated area) (Source: Authors' own elaboration)

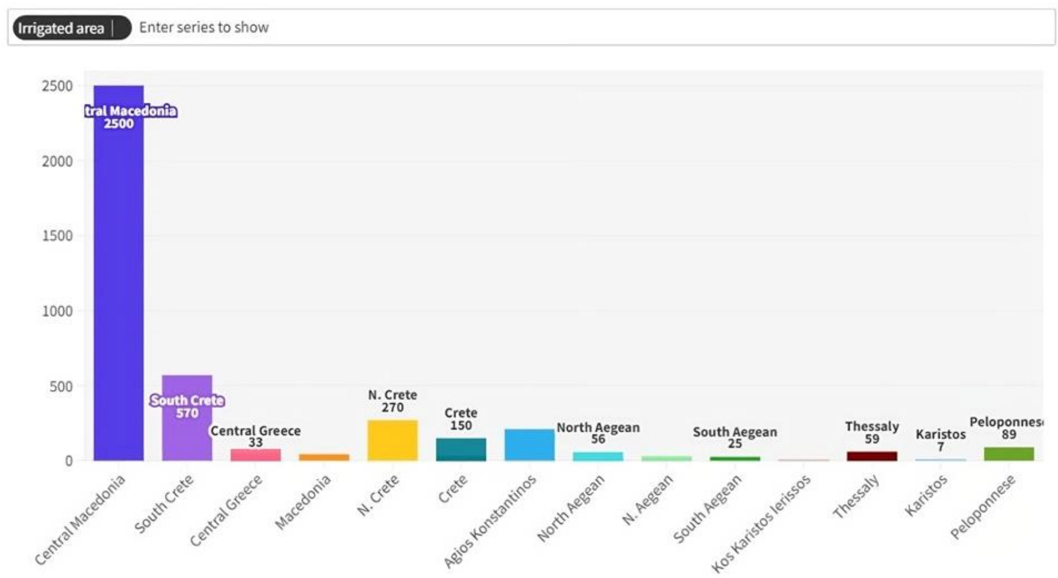

Figure 3. Significant wastewater reuse sites capacity of MELs (per range: m^3/day correlated irrigated area of Greece data sources & data variables bar charts) (Source: Authors' own elaboration)

These sources can provide information on water quality, health risks, and regulations for wastewater treatment and reuse in Greece. Water reuse is crucial for resource conservation, supporting the circular economy and protecting natural ecosystems (Andreadakis et al., 2006). Membrane bioreactor (MBR) technology plays a significant role in water reuse by providing high-quality treatment, fouling mitigation, and nitrification efficiency. MBR systems effectively remove suspended solids, pathogens, and contaminants from wastewater, meeting stringent standards.

They also contribute to fouling mitigation by maintaining stable microbial communities within the controlled environment. MBR systems also promote nitrification, a key biological process for converting ammonia to nitrate in wastewater treatment. Their compact design makes them suitable for decentralized water reuse applications in urban areas or limited space. Overall, water reuse is a critical strategy for sustainable water management, and MBR technology plays a significant role in achieving high-quality effluent for safe and efficient water reuse practices. MBR technology is known for its advanced treatment capabilities.

The use of membranes in MBR systems ensures a high level of effluent quality, meeting stringent water reuse standards. It effectively removes suspended solids, pathogens, and contaminants from wastewater. MBR technology, with its advanced treatment capabilities and fouling mitigation potential, plays a significant role in achieving the high-quality effluent required for safe and efficient water reuse practices (Du et al., 2020).

DISCUSSION & FUTURE PROSPECTS

To meet water needs in different countries, conventional water resources must be managed through new technologies and water-reducing devices. Unconventional water resources, such as desalinated, rainfall runoff, harvesting, and wastewater, should be implemented to reduce demand for freshwater resources. Efficient food and water transportation can balance the unequal distribution of water resources, and understanding regional climate can increase water collection (Kandiah et al., 2017). The use of brackish water and appropriate soil, crop, and irrigation management strategies can enhance agricultural productivity (Ilias et al., 2014; Paranychianakis et al., 2009; Qadir &; Oster, 2004). Cross-border water transfer projects require regional cooperation and trust between exporting and importing countries. Interregional issues may arise when communal aquifers are affected, strained relations between neighboring countries (FAO, 2003).

Data variables extracted from the legislation, focusing on aspects related to environmental hygiene and public health risks. Comparative framework used to compare European Commission's (2012) proposal with existing legislation in Greece. Coding or coded and categorized the relevant sections of the legislation for systematic comparison. The connections between climate change, environmental hygiene hazards, and public health, associated with public health workforce to protect citizens (Adamopoulou et al., 2023; Adamopoulos et al., 2022a, 2022b, 2023a, 2023b, 2023c, 2023d) highlight the need for a comprehensive and interdisciplinary approach to public safety and satisfaction and proper training of inspection workforce (Adamopoulos, 2022; Adamopoulos & Syrou, 2022; Adamopoulos et al., 2022b). This includes robust healthcare systems, effective emergency preparedness, sustainable environmental practices, and global policy administration and political intervention collaborations to address these complex challenges. There's a lack of critical case studies on wastewater management and water reuse, so research is crucial to maintain water quality, reduce pollution, and protect public health (Emelogu et al., 2019). The research on wastewater management and water reuse is limited due to the complex nature of the issues and to the entitled article (Chettiyappan & Vijayakumar, 2018). To address this, researchers should explore interdisciplinary studies, interdisciplinary reviews, and broader reviews that cover various aspects of these processes (Kumar & Dahiya, 2018). With academic institutions to access the latest research results and literature on these topics. Despite the lack of real-time access to databases, searching for relevant research articles and reports can provide valuable insights (Page et al., 2021).

Finally, we must recognize that the impact of climate crises and disasters must be managed effectively. These outcomes can have a significant impact on public health. Climate change is concerned with epidemiological models and policies regarding climatic elements such as temperature, precipitation, humidity, and health outcomes (Adamopoulos et al., 2023f).

CONCLUSIONS

Wastewater can be a valuable resource for agriculture if properly regulated and approved by the country. However, challenges such as planning and managing reuse operations, economic and financial practices, and training for farmers in economically poor countries need to be addressed. Investing in disinfection and treatment plants is crucial for sustainable use. Desalination of seawater and brackish groundwater can provide high-quality water, but it remains expensive for conventional crop production and in developing countries. Environmental regulations and practices are essential to prevent negative environmental impacts. Water resources of marginal quality are valuable in countries with water scarcity, but their use should be limited due to health and environmental risks. In Greece, the potential for reuse is limited due to the location of wastewater treatment plants. Integrated water management systems can address increasing pressure on water resources and promote efficient use of existing water, quality protection, and boundary waters. This proportion may increase in the near future as the number and capacity of wastewater treatment plants increases and as new facilities are integrated into wastewater reuse systems.

To achieve this, national water policy should be improved and expanded to encourage the safe use of recycled water for various uses. This study is a perspective qualitative analysis. selection of legislation, outline the criteria used for selecting the relevant legislation from EU and Greece. Data sources specify sources from obtained the legislation texts. This includes official government documents, legal databases, and reputable sources. Data variables extracted from the legislation, focusing on aspects related to environmental hygiene and public health risks. This study will help in decision-making, policy formulation and administration of organizations & services, proper governance, and future training programs in environmental hygiene on wastewater and water reuse.

Author contributions: IPA: supervision, validation, visualization, conceptualization, data curation, investigation, methodology, project administration, resources, software, writing–original draft, writing–editing, validation, & visualization & **NFS & JPA:** conception & design of work, data collection, interpretation, drafting article, critical future revision, & writing–original draft. They all agree with the results and conclusions.

Funding: No funding source is reported for this study.

Declaration of interest: No conflict of interest is declared by the authors.

Ethics statement: The authors stated that ethical approval of the research was carried out in accordance with the rules and current bioethics legislation, all the conditions and specifications of the National and European Union Legislation for the protection of personal data as well as in accordance with the instructions of the quality assurance and the study was carried out according to the Declaration of Helsinki. The authors further stated that the study does not involve conduct, research, experiment results or clinical trials on humans or animals, hence ethics committee approval was not required. The study is a systematic literature review that use publicly accessible documents as evidence.

Data sharing statement: Data supporting the findings and conclusions are available upon request from corresponding author.

REFERENCES

Adamopoulos, I. P. (2022). Job satisfaction in public health care sector, measures scales and theoretical background. *European Journal of Environment and Public Health, 6*(2), em0116. https://doi.org/10.21601/ejeph/12187

Adamopoulos, I. P., & Syrou, N. F. (2022). Associations and correlations of job stress, job satisfaction and burn out in public health sector. *European Journal of Environment and Public Health, 6*(2), em0113. https://doi.org/10.21601/ejeph/12166

Adamopoulos, I. P., Frantzana, A. A., Adamopoulou, J. P., Syrou N. F. (2023a). Climate change and adverse public health impacts on human health and water resources. *Environmental Sciences Proceedings, 26*(1), 178. https://doi.org/10.3390/environsciproc2023026178

Adamopoulos, I. P., Frantzana, A. A., & Syrou, N. F. (2023b). Epidemiological surveillance and environmental hygiene, SARS-CoV-2 infection in the community, urban wastewater control in Cyprus, and water reuse. *Journal of Contemporary Studies in Epidemiology and Public Health, 4*(1), ep23003. https://doi.org/10.29333/jconseph/12948

Adamopoulos, I. P., Lamnisos, D., Syrou, N. F., & Boustras, G. (2022a). Public health and work safety pilot study: Inspection of job risks, burn out syndrome and job satisfaction of public health inspectors in Greece. *Safety Science, 147*, 105592. https://doi.org/10.1016/j.ssci.2021.105592

Adamopoulos, I. P., Lamnisos, D., Syrou, N. F., & Boustras, G. (2022b). Training needs and quality of public health inspectors in Greece during the COVID-19 pandemic. *European Journal of Public Health, 32*(Supplement_3), ckac131.373. https://doi.org/10.1093/eurpub/ckac131.373

Adamopoulos, I. P., Syrou, N. F., & Adamopoulou, J. P. (2023c). European Union Commission's proposal on environmental hygiene and public health risks with existing legislation on wastewater and water reuse in Greece. *SSRN*. https://doi.org/10.2139/ssrn.4645621

Adamopoulos, I. P., Syrou, N. F., Lamnisos, D., & Boustras, G. (2023d). Cross-sectional nationwide study in occupational safety & health: Inspection of job risks context, burn out syndrome and job satisfaction of public health inspectors in the period of the COVID-19 pandemic in Greece. *Safety Science, 158*, 105960. https://doi.org/10.1016/j.ssci.2022.105960

Adamopoulou, J. P., Frantzana, A. A., & Adamopoulos, I. P. (2023e). Addressing water resource management challenges in the context of climate change and human influence. *European Journal of Sustainable Development Research, 7*(3), em0223. https://doi.org/10.29333/ejosdr/13297

Adamopoulos I., Frantzana A., & Syrou N. (2023f). Climate crises associated with epidemiological, environmental, and ecosystem effects of the storm, from flooding, landslides, and damage to urban and rural areas (Extreme weather events Daniel in Thessaly, Greece). Easy Chair Preprint no. 11058. https://easychair.org/publications/preprint/9hNx

Amec Foster Wheeler Environment. (2016). EU-level instruments on water reuse final report to support the Commission'S impact assessment. *European Union*. https://ec.europa.eu/environment/water/blueprint/pdf/EU_level_instruments_on_water-2nd-IA_support-study_AMEC.pdf

Andreadakis, A., Gavalaki, E., Mamais, D., Noutsopoulos, K., & Tzimas, A. (2003). Proposal for the establishment of quality limits and specifications for the reuse of wastewater in Greece. In *Proceedings of the Scientific Two-Day Conference: Wastewater Recovery and Reuse* (pp. 19-75).

Andreadakis, A., Mamais, D., & Gavalakis, E. (2006). Evaluation of treatment schemes appropriate for wastewater reuse in Greece. *International Journal of Environmental Technology and Management, 6*(5), 423-433. https://doi.org/10.1504/IJETM.2006.010475

Angelakis, A. N., Koutsoyiannis, D., & Tchobanoglous, G. (2005). Urban wastewater and stormwater technologies in ancient Greece. *Water Research, 39*(1), 210-220. https://doi.org/10.1016/j.watres.2004.08.033

Chartzoulakis, K. S., Paranychianakis, N. V., & Angelakis, A. N. (2001). Water resources management in the island of Crete, Greece, with emphasis on the agricultural use. *Water Policy, 3*(3), 193-205. https://doi.org/10.1016/S1366-7017(01)00012-5

Chettiyappan, P., & Vijayakumar, L. (2018). Wastewater, pollution prevention and control: A review on emerging environmental corporate management strategy. *Journal of Cleaner Production*.

del Tánago, M. G., De Jalón, D. G., & Román, M. (2012). River restoration in Spain: Theoretical and practical approach in the context of the European water framework directive. *Environmental Management, 50*(1), 123-139. https://doi.org/10.1007/s00267-012-9862-1

Directive 2006/118/EC. (2006). Directive 2006/118/EC. *European Parliament and Council*. https://eurlex.europa.eu/legalcontent/EL/TXT/PDF/?uri=CELEX:32006L0118&from=SV

Directive 91/271/EEC. (1991). Directive 91/271/EEC. *European Parliament and Council*. https://eur-lex.europa.eu/legal-content/EL/LSU/?uri=CELEX:31991L0271

Du, X., Shi, Y., Jegatheesan, V., & Haq, I. U. (2020). A review on the mechanism, impacts and control methods of membrane fouling in MBR system. *Membranes, 10*(2), 24. https://doi.org/10.3390/membranes10020024

Emelogu, E., Onuoha, E., Ujowundu, N., & Emejulu, I. (2019). Advances in wastewater-based epidemiology: A review. *Environmental Research*.

EUR-Lex-32000L0060-EN-EUR-Lex. (2020). EUR-Lex-32000L0060-EN-EUR-Lex. *European Parliament and Council*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32000L0060

European Authority Legislations. (2011). Joint ministerial decision 145116/2011. *Government Gazette 354/B/8-3-2011*. [online]. https://www.e-nomothesia.gr/kat-periballon/apobleta/kya-145116-2011.html

European Commission. (2012). *A blueprint to safeguard Europe's water resources: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*. Publications Office of the European Union.

European Water Resources. (2020). Overview. https://www.eea.europa.eu/archived/archived-content-water-topic/water-resources

Eurostat. (2018). Water exploitation index. *Eurostat*. https://ec.europa.eu/eurostat/web/products-datasets/-/t2020_rd220

FAO. (2003). Review of world water resources by country. *Food and Agriculture Organizations of the United Nations*. http://www.fao.org/tempref/agl/AGLW/ESPIM/CD-ROM/documents/5C_e.pdfhttp://www.fao.org/tempref/agl/AGLW/ESPIM/CD-ROM/documents/5C_e.pdf

Garcia, X., & Pargament, D. (2015). Reusing wastewater to cope with water scarcity: Economic, social and environmental considerations for decision-making. *Resources, Conservation and Recycling, 101*, 154-166. https://doi.org/10.1016/j.resconrec.2015.05.015

GENERATION 2.0 RED (2020). *Report on the Directorates of Foreigners and Immigration of the Decentralized Administration of Attica*. https://g2red.org/report-on-the-directorates-of-foreigners-and-immigration-of-the-decentralized-administration-of-attica/

Green, T. R., Taniguchi, M., Kooi, H., Gurdak, J. J., Allen, D. M., Hiscock, K. M., Treidel, H., & Aureli, A. (2011). Beneath the surface of global change: Impacts of climate change on groundwater. *Journal of Hydrology, 405*(3-4), 532-560. https://doi.org/10.1016/j.jhydrol.2011.05.002

Ilias, A., Panoras, A., & Angelakis, A. (2014). Wastewater recycling in Greece: The case of Thessaloniki. *Sustainability, 6*(5), 2876-2892. https://doi.org/10.3390/su6052876

Interwies, E., & Görlitz, S. (2012). *The role of water pricing and water allocation in agriculture in delivering sustainable water use in Europe*. Publications Office of the European Union

Jaramillo, M. F., & Restrepo, I. (2017). Wastewater reuse in agriculture: A review about its limitations and benefits. *Sustainability, 9*(10), 1734. https://doi.org/10.3390/su9101734

Kalavrouziotis, I. K., Kokkinos, P., Oron, G., Fatone, F., Bolzonella, D., Vatyliotou, M., Fatta-Kassinos, D., Koukoulakis, P. H., & Varnavas, S. P. (2015). Current status in wastewater treatment, reuse and research in some Mediterranean countries. *Desalination and Water treatment, 53*(8), 2015-2030. https://doi.org/10.1080/19443994.2013.860632

Kandiah, V., Binder, A. R., & Berglund, E. Z. (2017). An empirical agent-based model to simulate the adoption of water reuse using the social amplification of risk framework. *Risk Analysis, 37*(10), 2005-2022. https://doi.org/10.1111/risa.12760

Koutsoyiannis, D., Zarkadoulas, N., Angelakis, A. N., & Tchobanoglous, G. (2008). Urban water management in ancient Greece: Legacies and lessons. *Journal of Water Resources Planning and Management, 134*(1), 45-54. https://doi.org/10.1061/(ASCE)0733-9496(2008)134:1(45)

Kumar, A., & Dahiya, R. (2018). Water quality regulations: An overview. *International Journal of Environmental Research and Public Health*.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hrobjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ..., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71. https://doi.org/10.1136/bmj.n71

Panoras, A., Kehagia, U., Xanthopoulos, F., Doitsinis, A., & Samaras, I. (2001). The use of municipal wastewater in cotton irrigation. In *Proceedings of the Inter-Regional Research Network Meeting on Cotton*.

Panoras, G. A. (2011). *Accumulation of heavy metals in soil irrigated for many years with treated urban wastewater (No. GRI-2011-7546)*. Aristotle University of Thessaloniki.

Paranychianakis, N. V., Kotselidou, O., Vardakou, E., & Angelakis, A. N. (2009). *Greek regulations on wastewater reclamation and reuse*. Hellenic Union of Municipal Enterprises for Water Supply and Sewage.

Population.un.org. (2019). World population prospects. *United Nations*. https://population.un.org/wpp/

Pragya, N., Paudel, R., & Jones, W. (2019). Water reuse for agricultural irrigation: A review. *Sustainability*.

Prochaska, C., & Zouboulis, A. (2020). A mini-review of urban wastewater treatment in Greece: History, development and future challenges. *Sustainability, 12*(15), 6133. https://doi.org/10.3390/su12156133

Qadir, M., & Oster, J. D. (2004). Crop and irrigation management strategies for saline-sodic soils and waters aimed at environmentally sustainable agriculture. *Science of the Total Environment, 323*(1-3), 1-19. https://doi.org/10.1016/j.scitotenv.2003.10.012

Reznik, A., Feinerman, E., Finkelshtain, I., Fisher, F., Huber-Lee, A., Joyce, B., & Kan, I. (2017). Economic implications of agricultural reuse of treated wastewater in Israel: A statewide long-term perspective. *Ecological Economics, 135*, 222-233. https://doi.org/10.1016/j.ecolecon.2017.01.013

Ricart, S., & Rico, A. M. (2019). Assessing technical and social driving factors of water reuse in agriculture: A review on risks, regulation and the yuck factor. *Agricultural Water Management, 217*, 426-439. https://doi.org/10.1016/j.agwat.2019.03.017

Salgot, M., Priestley, G. K., & Folch, M. (2012). Golf course irrigation with reclaimed water in the mediterranean: A risk management matter. *Water, 4*(2), 389-429. https://doi.org/10.3390/w4020389

Sbirilis, N., & Kanaris, S. (2002). Wastewater reclamation and reuse in city of Chalkis, Greece. In *Proceedings of the IWA Regional Symposium on Water Recycling in Mediterranean Region*.

Smol, M., Adam, C., & Preisner, M. (2020). Circular economy model framework in the European water and wastewater sector. *Journal of Material Cycles and Waste Management, 22*, 682-697. https://doi.org/10.1007/s10163-019-00960-z

Thomas, J. S., & Durham, B. (2003). Integrated water resource management: Looking at the whole picture. *Desalination, 156*(1-3), 21-28. https://doi.org/10.1016/S0011-9164(03)00320-5

Tsagarakis, K. P., Dialynas, G. E., & Angelakis, A. N. (2004). Water resources management in Crete (Greece) including water recycling and reuse and proposed quality criteria. *Agricultural Water Management, 66*(1), 35-47. https://doi.org/10.1016/j.agwat.2003.09.004

Tsagarakis, K. P., Mara, D. D., & Angelakis, A. N. (1998). Evaluation of wastewater treatment plants in Greece. *Technica Chronica I* [*Technical Chronicle I*]*, 18*(3), 97-109.

Tzanakakis, V., Koo-Oshima, S., Haddad, M., Apostolidis, N., Angelakis, A. N., Angelakis, A., & Rose, J. (2014). The history of land application and hydroponic systems for wastewater treatment and reuse. In *Evolution of sanitation and wastewater technologies through the centuries*. IWA Publishing.

WHO. (2006). Guidelines for the safe use of wastewater, excreta and greywater. *World Health organization*. https://www.who.int/publications-detail-redirect/9241546859

Wichelns, D., Drechsel, P., & Qadir, M. (2015). Wastewater: Economic asset in an urbanizing world. In *Wastewater* (pp. 3-14). Springer. https://doi.org/10.1007/978-94-017-9545-6_1

Xanthoulis, D. (2010). *Report on wastewater reuse and sludge valorization and reuse: Proposition for Lebanese wastewater reuse guidelines*. https://www.h2020.net/fr/component/jdownloads/send/27-lectures/360-wastewaterandsludge