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Conventional water resources associated with climate change in the Southeast Mediterranean and the Middle East countries

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ABSTRACT

Conventional water sources in the Southeast Mediterranean and the Middle East play a crucial role in driving the socio-economic progress of the region. This study aims to address the uncertainties, discrepancies, and gaps in knowledge regarding how to combat the climate crisis and extreme weather events impacting traditional water sources. These sources encompass rivers, lakes, reservoirs, and groundwater reservoirs that are vital for agriculture, industry, and daily household needs. The availability and upkeep of water resources in this area are influenced by factors like climate change, population growth, and competing demands from different sectors. The methodology involved an extensive review of research literature curetted from a wide array of international scientific studies and reports, drawing data from sources such as PubMed, EBSCO, Medline, EMBASE, CINAHL, Scopus, Web of Science, Science Direct, Google Scholar, and UNESCO, WHO databases. The findings underscore the importance of traditional water sources in these regions, underscoring their significance for agricultural, industrial, and domestic applications. The accessibility of water resources varies among nations, with some grappling with water scarcity issues. This research delves into the condition of traditional water sources in the Southeast Mediterranean and the Middle East, shining a spotlight on concerns like water scarcity, pollution, and governance, offering valuable insights into these critical resources.

Keywords: conventional water, environmental hygiene, climate change, Southeast Mediterranean countries, water resources, Middle East, global public health, climate risks

INTRODUCTION

Water resources are essential sources of sustenance for all living beings. Traditional water sources are renewable and include rivers, lakes, freshwater wetlands, and groundwater. It is worth noting that only 3% of the Earth's water is fresh water, with the majority being trapped in glaciers and ice caps air (Wada et al., 2016). The availability of clean and fresh water is diminishing globally, creating a growing concern for water conservation and ecosystem preservation (Hoekstra & Mekonnen, 2012).

The loss of over half of the world's wetlands has highlighted the urgent need to protect these valuable environmental resources (Hoekstra & Mekonnen, 2012). Surface water, found in rivers, lakes, and freshwater wetlands, is naturally replenished by rainfall but can be lost through evaporation and discharge into the oceans. Human activities also play a significant role in altering surface water storage through the construction of tanks, land development, and water diversion projects (Delpla et al., 2009).

The key factor in water management is the efficient utilization of available resources in a given area, as highlighted by Galewsky et al. (2016). Freshwater can either be sourced from surface water bodies or groundwater found in soil and rock. Groundwater has a slower turnover rate compared to surface water, making it a reliable and abundant source of water for prolonged use without depletion concerns. It flows into the ground through surface water leakage and can be enhanced by redirecting and enriching it from surface water through the construction of reservoirs or containment tanks (Galewsky et al., 2016).

Water services are considered essential services that are provided for the benefit of the general public. These services include a range of activities such as the extraction, storage, treatment, and distribution of surface water and groundwater, as well as the collection and treatment of wastewater before it is discharged into surface water bodies (water use and environmental pressures, 2019). Since the management of water services is typically handled at a national level, the specific definition of 'water services' can vary from one country to another.

While the provision of drinking water (DW) and the management of wastewater is universally included in the definition of 'water services', some countries may have additional activities included under this umbrella term. For example, water management responsibilities may or may not fall under the scope of water services depending on the country. In certain cases, water service providers may also be responsible for activities such as flood protection and water recycling. The organization of water services within each country is influenced by various historical and cultural factors, leading to a diverse range of approaches.

To simplify matters, we can categorize four management models, each with its own specific aims as outlined in this study:

1. The system of direct public management, the public body in charge takes full responsibility for providing and handling services.
2. The system of delegated public management, a management entity is selected by the relevant public body to manage the tasks. In most cases, these management entities remain under public sector ownership, though there may be some instances of private participation.
3. Delegated private management involves the appointment of a private company by the public body to manage tasks through a time contract such as a lease or concession. In countries where this model is common, municipalities often outsource their tasks to private companies while still retaining ownership of the infrastructure.
4. Under direct private management, all responsibilities and ownership of utilities are transferred to private entities. Public entities then focus on regulation and oversight. This model is not widely implemented globally, with a majority of countries leaning towards a combination of direct public management, delegated public management, and delegated private management.

Overall, there has been a shift towards public and private delegated management over the past two decades. Public authorities play a key role in approving tariffs, ensuring service quality, and establishing and enforcing environmental and health standards.

Typically, water tariffs are suggested by the water provider to the relevant authority (such as the municipality, regional government, regional regulatory body, national ministry, or independent national regulatory authority) for approval. Some cases may involve customer participation in the decision-making process. In certain instances, oversight bodies conduct a post-audit of the bill. The competent authority may establish service quality standards based on specific minimum criteria in certain situations. Depending on the country and the organizational structure of water services, customers have various avenues to lodge complaints, including utility customer service, municipalities, consumer councils, national regulators, mediators, arbitration boards, and courts. The monitoring of DW quality is typically overseen by health authorities (such as the Ministry of Health and local/regional health bodies). The protection of water resources and the establishment of environmental regulations are usually the responsibility of the Ministry of Environment, river basin authorities, regional bodies, and national environmental agencies. In general, tackling the problem of water shortage requires the application of a range of water collection techniques in areas with different rainfall amounts (Adamopoulos et al., 2024c). Communities may better manage their water resources and guarantee access to clean water for both current and future generations by diversifying their water sources and putting sustainable policies into effect (Gleick, 1998). Regarding water quality, European regulations and directives mandate a series of water treatment processes for DW, with regular microbiological and chemical testing conducted by water providers, the state's central chemical laboratory, and university labs. In Greece, water usage is categorized into agriculture, domestic, and industrial sectors. However, accurate measurement is challenging due to limited consumption monitoring tools and the prevalence of unauthorized drilling and unrecorded abstractions (Sofios et al., 2008). Adaptation strategies in Southeast Mediterranean and Middle Eastern countries are crucial for enhancing resilience to severe weather events and combating climate change's impact on traditional water resources (Chiabai et al., 2018). Sustainable water resource management, including investment in infrastructure and conservation practices, can improve efficiency and reduce waste during droughts (Juhola et al., 2022). The membrane bioreactor (MBR) is an innovative technique used for treating municipal wastewater, utilizing a combination of membrane separation and biological treatment processes. The challenge of membrane fouling is thoroughly examined, detailing the various types, sources, and manifestations of fouling. Factors that contribute to fouling are examined in depth, such as operational parameters, influent quality, microbial activity, and membrane properties, drawing from recent research findings. Solutions to combat fouling issues are explored, including chemical and physical cleaning methods, biological controls, electrical treatments, and modifications to membranes and modules (Hai et al., 2019; UNESCO, 2016). MBR technology and biological systems are reliable water supply approaches based on the below studies conducted by UNESCO (2016):

1. effect of the nitrifiers community on fouling mitigation and nitrification efficiency in an MBR,
2. interaction between chlorella vulgaris and nitrifying-enriched activated sludge in the treatment of wastewater with low C/N ratio, and
3. activity enhancement of ammonia-oxidizing bacteria and nitrite-oxidizing bacteria in activated sludge process: metabolite reduction and CO_2 mitigation intensification process.

MBR is an innovative approach to treating municipal wastewater, utilizing a combination of membrane separation and biological treatment processes. With a focus on understanding membrane fouling, this method addresses the various types, sources, and manifestations of fouling (Hai et al., 2019; Qrenawi & Rabah, 2024). Factors influencing fouling, such as operational parameters, influent composition, biomass concentration, and membrane properties, have been extensively analyzed based on the most recent research findings. Strategies to mitigate fouling issues include chemical and physical cleaning, biological and electrical control, as well as modifications to membranes and modules (Qrenawi & Rabah, 2024). Climate-smart agriculture practices, such as drip irrigation and drought-resistant crops, can help farmers withstand climate change impacts. Early warning systems and disaster preparedness measures reduce the impact of severe weather events on vulnerable populations (Wolf et al., 2015). Implementing adaptation strategies is crucial for enhancing resilience to severe weather events and combating climate change's impact on traditional water resources in Southeast Mediterranean and Middle Eastern countries (Adamopoulos et al., 2024b; Rezvani et al., 2018).

Study's hypothesis and clear questions to resolve:

- *Improve the climate change is affecting conventional water resources in the Southeast Mediterranean and Middle East countries.*
- *Variable rainfall patterns and rising temperatures are affecting surface water sources like rivers and lakes.*
- *Rising temperatures and evaporation rates further reduce available water for agricultural, industrial, and domestic use.*
- *Policymakers must work towards sustainable management to mitigate these effects.*
- *Climate change is causing a significant depletion of groundwater resources in the Southeast Mediterranean and Middle East, causing over-extraction and contamination.*
- *Climate change, altering aquifer recharge rates and increasing saltwater intrusion.*
- *To adapt, sustainable water management practices, such as conservation measures and diversification of water sources, are needed.*
- *Understanding the complex interactions between climate change and water resources is crucial for a sustainable future.*

METHODS MATERIALS & STUDY'S DESIGN

This scoping review of literature is rooted in the author's vast practical experience as a public and environmental health inspector in Greece for over two decades. The primary objective of this study is to delve into the repercussions of traditional water sources in the face of climate change. The core purpose of this assessment is to untangle any uncertainties, inconsistencies, and knowledge voids concerning methods to combat the climate emergency and severe weather occurrences. A comprehensive analysis of original research papers concerning exposure and impacts on conventional water reservoirs in the Southeast Mediterranean and the Middle East has been meticulously conducted through

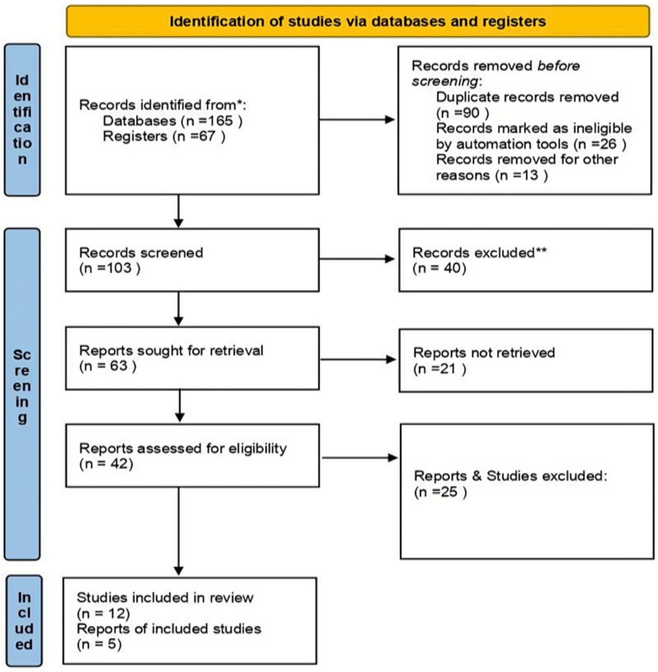

Figure 1. PRISMA 2020 diagram illustrating the process of conducting reviews, involving searches of databases and registers (Source: Authors' own elaboration)

various scholarly databases. The information curated in this review has been carefully curated from a diverse array of global scientific studies, sourced from reputable platforms such as PubMed, EBSCO, Medline, EMBASE, CINAHL, Scopus, Web of Science, Science Direct, Google Scholar, and UNESCO, WHO databases. There exists a pressing demand for additional research to tackle the dilemmas of water scarcity and foster sustainable water management practices in the area, a critical necessity to bolster various industries. The articles scrutinized in this inquiry were authored or published in English within the last two decades. In tandem with examining literature on traditional water resources in the Southeast Mediterranean and the Middle East, references from these publications were meticulously reviewed. Data on water accessibility and utilization across different nations was thoroughly analyzed, with specific key terms pinpointed for this investigation. The crucial factors influencing water resources in the region were also underscored. This research was conducted from December 2023 to February 2024, encompassing vital stages such as formulating hypotheses and research inquiries, setting inclusion criteria for pertinent studies, choosing suitable studies, presenting data via tables and figures, and deriving conclusions and disclosing results. **Figure 1** illustrates the flow chart of the study (Page et al., 2021).

RESULTS

Conventional water sources are essential for supporting agriculture, industry, and households in the Southeast Mediterranean and Middle Eastern countries. The availability of water varies between nations, with some struggling with scarcity issues in the region. Climate change and population growth are major factors that influence water resources in this area.

In conclusion, conventional water sources in the Southeast Mediterranean and Middle Eastern countries are crucial for the survival of various sectors. More research is necessary to address the challenges of water scarcity and ensure sustainable water resource management in the region.

Figure 2, **Figure 3**, and **Figure 4** illustrate the distribution of water resources in different sectors affected by climate change.

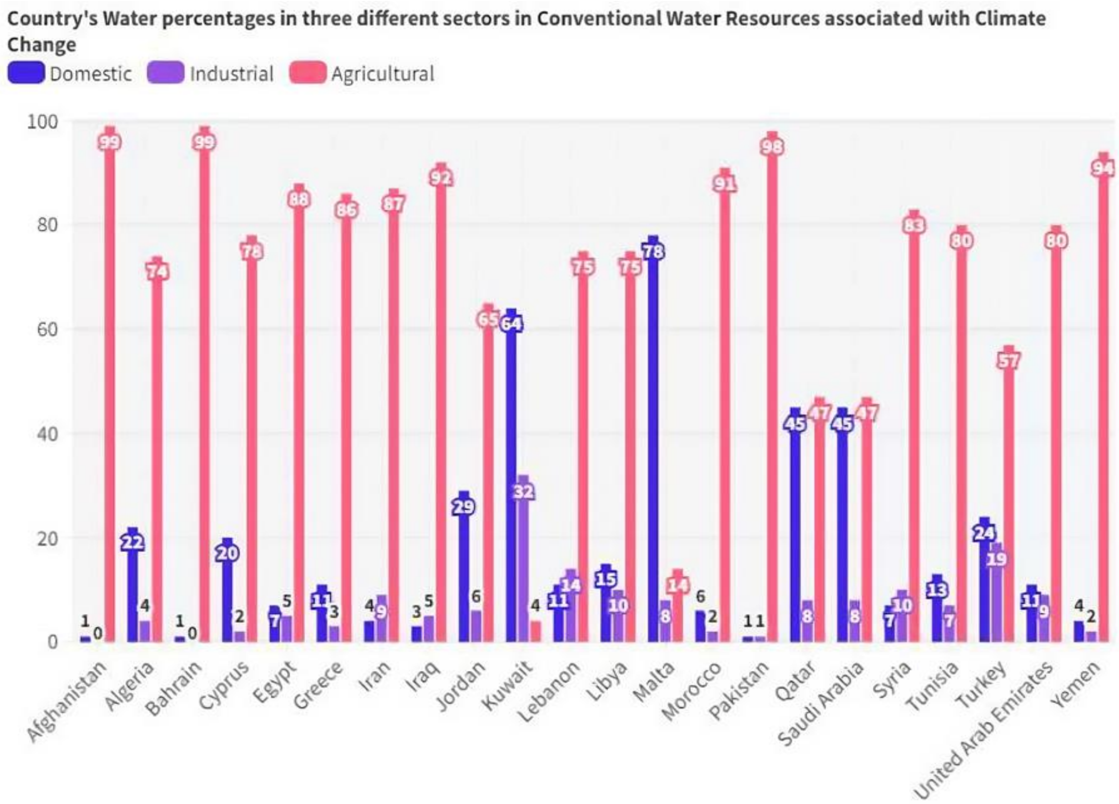

Figure 2. Water distribution across three distinct sectors within in regions of the Southeast Mediterranean and Middle Eastern countries (Source: Authors' own elaboration)

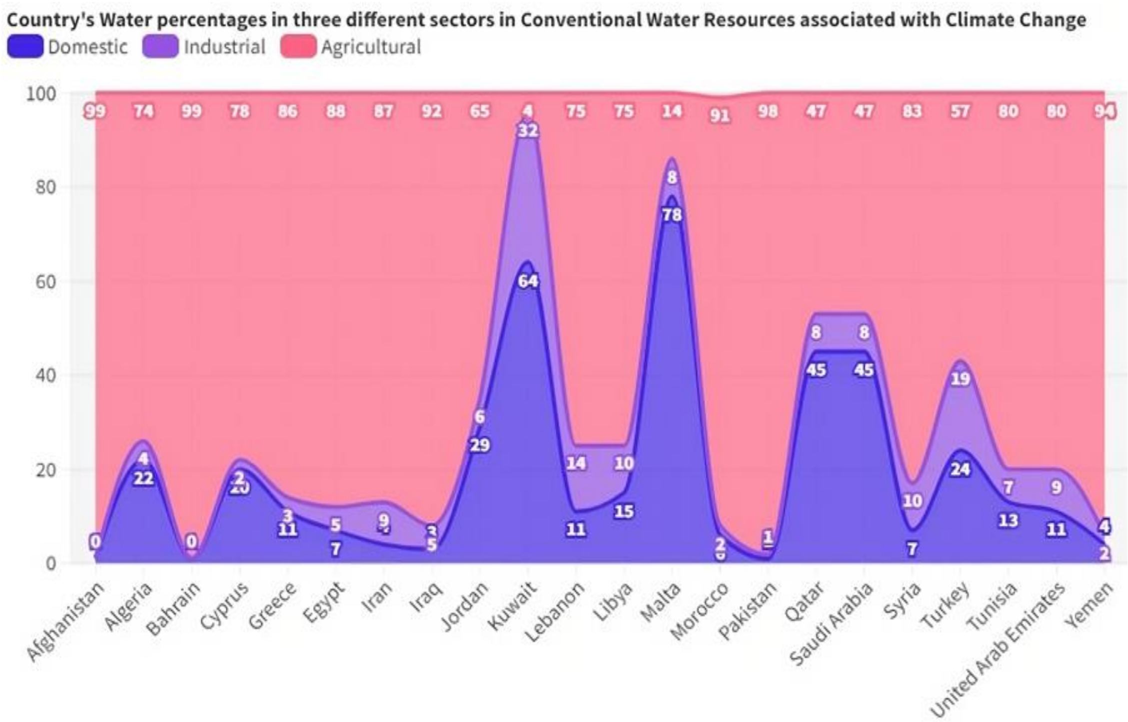

Figure 3. The distribution of water resources among various sectors in a country, on conventional water resources and their connection to climate change in Southeast Mediterranean and Middle Eastern countries (Source: Authors' own elaboration)

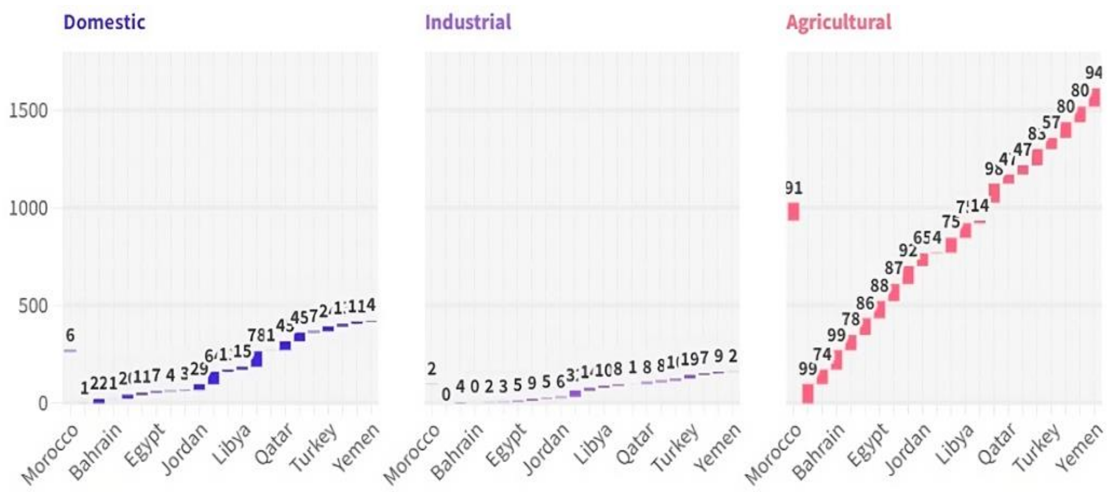

Figure 4. The distribution of water resources across various sectors within a country, in the context of conventional water sources and their connection to climate change in Southeast Mediterranean and Middle Eastern nations (Source: Authors' own elaboration)

Numerous factors influencing water resources in the Southeast Mediterranean and Middle Eastern countries, such as the wide range of bio-geographical characteristics, the region's dramatic population growth in recent decades, significant societal and economic changes, and armed conflicts in some of the region's countries, pose special challenges. The region's problems with water and energy security will get worse due to predicted changes in the environment (Lange, 2019). The majority of the Earth's freshwater supply is earmarked for agricultural use.

Table 1 illustrates the rates of water consumption across various sectors relevant to climate change in the Southeast Mediterranean and Middle Eastern nations.

In a study conducted by de Souza Melo et al. (2020), a survey was carried out between May and October of 2017 at the Federal Agrarian University of Semiarid in Mossoró. The research was conducted using a randomized complete block design with split plots. Different levels of treated grey water (TGW) and/or DW dilution were applied to plots of land (100% DW, 25% TGW + 75% DW, 50% TGW + 50% DW, 75% TGW + 25% DW, and 100% TGW). de Souza Melo et al. (2020) conducted a study that investigated how different levels of diluted TGW affect the growth of sunflowers. The study revealed that using higher dilution levels of TGW led to a significant increase in both the growth and yield of sunflowers. These key findings are important as they offer insights into how TGW can be utilized to improve crop production without depleting freshwater resources. The study also emphasized the necessity of proper treatment methods to ensure that grey water is safe for agricultural use. In summary, the research underscores the potential advantages of incorporating TGW into agricultural practices to support sustainable water management efforts. The study findings indicated that the combination of grey water dilution levels and sunflower cultivation did not have a significant impact on the variables studied, such as stem diameter, capitulum, and plant height, which are crucial for determining the commercial value of ornamental plants (de Souza Melo et al., 2020). A total of 120 experimental units were designated for two sunflower cultivars on separate plots in the greenhouse. Grey water for the experiment was collected from showers, bathroom sinks, and a kitchen, while DW was sourced from the municipal water supply system. The rates of water consumption vary significantly across different sectors, as illustrated in **Table 1**.

Table 1. Water percentages in three different sectors sources

(Country)	**[Domestic]**	**[Industrial]**	**[Agricultural]**
(-Afghanistan)	[1]	[0]	[99]
(-Algeria)	[22]	[4]	[74]
(-Bahrain)	[1]	[0]	[99]
(-Cyprus)	[20]	[2]	[78]
(-Greece)	[11]	[3]	[86]
(-Egypt)	[7]	[5]	[88]
(-Iran)	[4]	[9]	[87]
(-Iraq)	[3]	[5]	[92]
(-Jordan)	[29]	[6]	[65]
(-Kuwait)	[64]	[32]	[4]
(-Lebanon)	[11]	[14]	[75]
(-Libya)	[15]	[10]	[75]
(-Malta)	[78]	[8]	[14]
(-Morocco)	[6]	[2]	[91]
(-Pakistan)	[1]	[1]	[98]
(-Qatar)	[45]	[8]	[47]
(-Saudi Arabia)	[45]	[8]	[47]
(-Syria)	[7]	[10]	[83]
(-Turkey)	[24]	[19]	[57]
(-Tunisia)	[13]	[7]	[80]
(-United Arab Emirates)	[11]	[9]	[80]
(-Yemen)	[4]	[2]	[94]

The data shows that the agricultural sector utilizes the highest percentage of water resources, highlights the vital role it plays in food production and crop irrigation. In contrast, the industrial sector, emphasizing the importance of water in manufacturing processes and industrial activities. This sector tends to require large quantities of water for various purposes, such as cooling systems and production processes. On the other hand, the domestic sector uses the least amount of water is crucial for providing clean and safe DW to households and communities. The distribution of water resources in these regions is heavily influenced by the demands of each sector. Overall, the rates of water consumption across various sectors, as depicted in **Table 1**, reflect the distribution of water resources in these regions and highlight the different priorities and demands of each sector. It is essential to continue monitoring and managing water usage effectively to ensure the sustainable and equitable distribution of water resources in the future. The study are extensively validated its results through various methods. First and foremost, the researchers utilized advanced review studies and provide analysis to determine the correlation between climate change and the availability of conventional water resources in the region. Additionally, they conducted to collect primary data on the current state of water resources in different countries. The results are descriptive and referred as presented after mentioned and modified from analytical manner form. Moreover, remote sensing techniques were employed to monitor changes in water availability over time. Overall, the rigorous validation process employed in this study ensures the credibility of its findings and contributes significantly to understanding of the impact of climate change on water resources in the Southeast Mediterranean and the Middle East countries. Conducting sensitivity analyses is crucial in assessing the robustness of results in studies related to conventional water resources and climate change in the Southeast Mediterranean and the Middle East countries. By exploring the impact of excluding studies based on certain criteria we can ensure the reliability and validity of the findings. In conclusion, conducting sensitivity analyses to assess the robustness of results in studies related to conventional water resources and climate change in the Southeast Mediterranean and the Middle East countries is essential for ensuring the reliability and validity of the findings. Exploring the impact of excluding studies based on certain criteria, can identify any potential biases, test the stability of the results, and quantify the uncertainty associated with their findings.

The characteristics of the water used in the study are outlined in **Table 2**.

DISCUSSION

There are different ways to collect water. Some methods are big and collect water from hills or dry areas. Other methods are small and collect water from roofs or small areas. Water is stored in reservoirs for later use (Boers et al., 1986). Macro-collection techniques are ways to collect water from hills or small dry areas. Rainwater can also be collected from roofs or sloping areas and saved in containers. This water can be used for homes and gardens. In some countries, like Sweden, Brazil, and the UK, collecting rainwater is important for DW (Ghisi & Ferreira, 2007). In Jordan, people collect water from their roofs when it rains. This water is usually clean and safe to drink (Abdulla & Al-Shareef, 2009). They also collect rainwater in fields to use for farming. By using special ponds and maps, they can collect water in the best places. In areas with not much rain, they use special beams to help with erosion Alkouri (2011). We can make water in different ways, like using artificial rain. But it depends on things like the type of soil, how steep the land is, how much rain there is, and how people farm the land. To make artificial rain, we need a lot of water in the air refer well conducted by Moseman (2009). The United Arab Emirates (UAE) made it rain on purpose using special planes and chemicals to help make more water for things like farming, factories, and tourists. This is important because it helps save water and makes it easier for people to have enough to drink and use. The UAE had a lot of rain in Dubai, which was the most rain they have had since 1977. Scientists have found a way to make rain using artificial methods that is cheaper than other ways of getting water (Breed et al., 2005). Rainwater is water that comes from the sky when it rains. People collect and save this water to use when there is not enough water. They use it for growing plants, watering gardens, and taking care of trees. Some countries that do not get a lot of rain have built special systems to save and move the water to where it is needed (Cheng & Liao, 2009). These systems help make sure we have enough water, even when it doesn't rain much, and they help keep us safe from water problems (Kfouri et al., 2009). Grey water is water that we use for things like taking baths and doing laundry. It is becoming more important because there is not enough fresh water for everyone. People are finding ways to use grey water instead of wasting it (Eriksson et al., 2002). Grey water is water that has been used for things like washing dishes or taking a shower. It can make up a lot of the water we use at home. The amount of grey water we make can depend on how we live our lives and how much water we have available. In some places, like Oman, most of the water used in sinks, showers, and kitchens is grey water (Burnat & Eshtayah, 2010; Jamrah et al., 2008). In Jordan, people produce a lot of grey water every day, about 50 liters per

Table 2. Characteristics such as supply units, quality categories of water, and parameters linked with them are crucial in evaluating water quality (these include electrical conductivity [EC], sodium absorption ratio [SAR], biochemical oxygen demand [BOD], chemical oxygen demand [COD], total suspended solids [TSS], and total solids [TS] analysis)

Supply units and parameter	Quality types of water		Measures of templates
(mmolc L-1)/(mg L-1)/(μC)/(NTU)/	Fresh drinking water	Treated gray water for others uses	
(1) Temperature (C°)	(21.00)	[22.00]	{< 401}
(2) pH	(7.80)	[7.50]	{6.0-8.51}
(3) EC (dS m−1)	(0.53)	[0.74]	{⩽ 3.01}
(4) SAR	(6.90)	[5.50]	{⩽ 15.01}
(5) Cl−	(2.40)	[8.00]	{30.04}
(6) CO_3 2−	(0.60)	[0.00]	{⩽ 0.14}
(7) HCO_3−	(2.60)	[2.70]	{⩽ 10.04}
(8) Na+	(4.39)	[5.07]	{⩽ 40.04}
(9) K+	(0.24)	[0.43]	{⩽ 0.054}
(10) Mg_2+	(0.22)	[0.78]	{⩽ 5.04}
(11) Ca_2+	(0.30)	[1.21]	{⩽ 20.04}
(12) P	(0.17)	[0.25]	{⩽ 2.04}
(13) N total	(2.11)	[14.13]	{⩽ 15.02}
(14) NH_4	(0.20)	[4.47]	{⩽ 5.02}
(15) Hardness	(30.00)	[109.00]	{75.0-300.05}
(16) BOD	(-)	[27.20]	{⩽ 120.01}
(17) COD	(-)	[160.00]	{⩽ 200.01}
(18) TSS	(-)	[30.00]	{⩽ 100.0 1}
(19) TS	(-)	[474.00]	{-}
(20) Apparent color	(-)	[160.00]	{-}
(21) Turbidity	(-)	[4.70]	{⩽ 5.0 3}

person. Grey water is water that comes from washing dishes, clothes, and taking showers (Faruqui & Al-Jayyousi, 2002). People in North Africa are trying to save water by using "grey water" for things like watering plants. Grey water is water that has been used for things like washing dishes or taking a bath. By using grey water, they can save a lot of fresh water. But they need to be careful because there can be germs in the grey water that can make people sick (Ghisi & Ferreira, 2007; Widiastuti et al., 2008). In places where there is not a lot of water, like Cyprus, people are using grey water systems to save water. This has helped them use 40% less water (Adamopoulos et al., 2023c). The World Health Organization (WHO) says that local communities can help manage grey water instead of big companies. Grey water can have different things in it depending on where it comes from. It usually has fewer bad things in it than regular wastewater (Ligtvoet et al, 2014; WHO, 2006). In this point is important to mentioned the MBR and biological systems are considered a dependable method for water supply, as supported by research conducted by UNESCO (WWAP-UNESCO, 2017). The impact of nitrifiers community on reducing fouling and improving nitrification efficiency in an MBR. The interaction between chlorella vulgaris and nitrifying-enriched activated sludge in treating wastewater with a low C/N ratio. Enhancing the activity of both ammonia-oxidizing bacteria and nitrite-oxidizing bacteria in the activated sludge process, leading to reduced metabolites and intensified CO2 mitigation (Iorhemen et al., 2016; WWAP-UNESCO, 2017). Grey laundry water can have high pH levels, which can be bad for the environment. To use this water again, it needs to be cleaned and treated with chemicals before it can be reused. There are rules about how clean the water needs to be before it can be used for things like flushing toilets (Eriksson et al., 2002; Li et al., 2009). Grey water is water that has been used for things like washing dishes or taking a shower. People are finding ways to clean this water so it can be used again for watering plants. This helps save water and is good for the environment.

As per regulations from the United States Environment Agency (USEPA) and research conducted by Li, Wichmann, and Otterpohl in 2009, it is advised that gray water should undergo filtration, disinfection, and biological treatment before being used to prevent ecosystem contamination. The IPC International Plumbing Code 2000 states that gray water can be repurposed for flushing toilets if tests show no detectable coliforms in 100mL of the liquid. The potential for using gray water has garnered attention from water management organizations and researchers alike. Various methods have been developed and implemented for processing gray water such as natural zeolites (Widiastuti et al., 2008), mulch tower systems consisting of mulch, coarse sand, fine and coarse gravel (Zuma et al., 2009), bioreactors (Eriksson et al., 2002), aerobic and anaerobic bio-filters, bio-rotors, submerged aerated filters, bio-rolls (Allen et al., 2010), chemical treatment using flocculants and ion exchange, and artificial wetlands (Pidou et al., 2008). The current state of public health is being significantly influenced by various factors, particularly the growing implications of climate change. This has led to numerous challenges impacting both human health and water resources (Adamopoulos et al., 2024b). In order to promote sustainable practices and enhance public health, it is crucial to reassess the intricate connection between climate change and the environment (Adamopoulos et al., 2023b, 2024c). It is imperative to rethink how people interact with their surroundings and encourage more sustainable decision-making. Scientific evidence indicates that the complex relationships between humans, animals, and the environment continue to pose new challenges regularly (Adamopoulos et al., 2023c), resulting in the emergence of diseases that can lead to widespread outbreaks and pandemics. Water plays a significant role in facilitating the trade of food between countries that have an excess of water resources and those that are lacking in water. This is crucial for countries experiencing water scarcity, as they often need to import food to maintain food security. The use of wastewater for irrigation raises concerns for public authorities tasked with safeguarding public health and environmental integrity (Qadir et al., 2007, 2010). Moreover, increased investment is necessary to effectively utilize existing water sources and preserve potable water (Adamopoulos et al., 2023d). Educating and motivating public health professionals is essential to ensuring the provision of high-quality services, upholding job satisfaction, and securing public approval (Adamopoulos, 2022; Adamopoulos et al., 2023d). Elevated levels of harmful bacteria, organic waste, solid particles, and various contaminants can be detected in the water bodies where these discharges occur. The frequency and intensity of CSO release are significantly impacted by weather conditions that govern the flow of rainwater from urban areas, particularly the volume and strength of rainfall, also in the water reuse in Middle Eastern and North African countries. (Abdellatif et al., 2014; Bahri, 2008; Morris, 2014; Wichelns et al., 2015). The impact of political actions can exacerbate employee fatigue, underscoring the importance of continuous support and intervention (Adamopoulos et al., 2022; Adamopoulos, 2023). Recognizing the crucial need to efficiently manage the aftermath of climate-related crises and disasters is vital, as these events can have a profound effect on public health. Climate change requires the exploration of epidemiological models and the development of policies based on meteorological factors like temperature, precipitation, and humidity, and their implications on health outcomes, and key technological climate goals (Adamopoulos et al., 2024a; Waisman et al., 2019).

Study's Limitations and Strengths

Study's limitations are that including sampled data from the PubMed, EBSCO, Medline, EMBASE, CINAHL, Scopus, Web of Science, Science Direct, Google Scholar, and UNESCO, WHO databases. Non-indexed journals most likely do no better than the ones we sampled, though. An additional constraint is the duration of the sample. Incorporating absolute estimates is probably going to take more time, but it will probably happen gradually. Our study's strengths include clear eligibility requirements and independent, duplicate eligibility determination. Strengths of our study include explicit eligibility criteria with independent duplicate adjudication of eligibility.

CONCLUSIONS

In order to effectively combat the impact of climate change, crises, and disasters, it is crucial to implement adaptation strategies that enhance resilience to severe weather events such as storms. It is important to recognize the intricate relationship between human society and the environment and take actions that benefit both the natural world and the communities that rely on it. A holistic approach is necessary to address both the immediate and long-term consequences of storms on ecosystems, in order to protect biodiversity, ecosystem services, and overall environmental well-being. To address the effects of storms on ecosystems, it is essential to prioritize habitat restoration and protection efforts, carry out ecological assessments to determine the extent of damage, and implement conservation measures to safeguard endangered and vulnerable species. This research focuses on identifying uncertainties, inconsistencies, and knowledge gaps in strategies to tackle the climate crisis and extreme weather events that impact traditional water resources. Water availability and management in the region are influenced by factors such as climate change, population growth, and competing demands from different sectors. The study underscores the importance of traditional water resources in the Southeast Mediterranean and the Middle East, particularly for agricultural, industrial, and domestic use. Water availability varies across countries in the region, with some facing challenges of water scarcity. It is imperative to adjust management practices, promote sustainable land use, and enhance disaster readiness to reduce future risks. Additionally, raising public awareness and conducting education campaigns are crucial to emphasize the significance of this study, which delves into the status of traditional water resources in these regions. The study addresses critical issues such as water scarcity, pollution, and governance, offering valuable insights into these vital resources. National water policies should be enhanced and broadened to encourage the safe utilization of recycled water for various purposes. Climate change is significantly affecting water resources in the Southeast Mediterranean and Middle East, leading to water scarcity for domestic and agricultural purposes. Sustainable water management strategies, such as rainwater harvesting, water recycling, and efficient irrigation, are crucial for long-term sustainability. International cooperation is essential to address water scarcity issues, considering future climate scenarios. Addressing these challenges requires concerted action, international cooperation, and climate change considerations in water resource planning to ensure water security for current and future generations.

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