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Editorial

Water, Resources, and Resilience: Insights from Diverse Environmental Studies

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1. Introduction

Water is our most precious resource, and its responsible management and utilization are paramount in the face of ever-growing environmental challenges. "Water, Resources, and Resilience: Insights from Diverse Environmental Studies" explores a diverse array of water-related topics, showcasing the vital role water plays in our lives and ecosystems. This work delves into water's usage, challenges, and innovative solutions, drawing from a wide range of environmental studies. This work maintains an encompassing scope, addressing subjects as varied as the equitable allocation of water resources, the intricacies of soil substrates, the sustainable generation of energy, and the critical interplay between water and public health [1,2]. It encapsulates the essence of water, elucidating its fundamental contribution to life's sustenance, as well as its pivotal role in supporting agricultural practices, industrial processes, and energy production [3–7]. The work, with astute foresight, not only recognizes the contemporary status of water resources but also casts a discerning glance at the looming challenges precipitated by surging global population, climate change, and pollution, all of which accentuate the global water crisis [8–12].

Furthermore, this collection places significant emphasis on the harnessing of advanced technologies and analytical tools, as these have emerged as indispensable instruments in refining our understanding, efficient management, and judicious utilization of water resources [13–15]. Computational modeling, data-driven analyses, and the adept use of geographic information systems are fundamental in several of the articles, facilitating precise assessments, predictive simulations, and the identification of emerging trends [16–19].

Our motivation for compiling this scientific work arises from the urgent need to address water-related concerns that impact global sustainability [20–22]. The growing water crisis, exacerbated by factors such as climate change, population growth, and pollution, has compelled us to gather insights from various environmental studies [23–33]. We aim to disseminate knowledge that can drive positive change and foster innovative solutions for the responsible and sustainable management of our water resources [34–42].

The Special Issue was intended for a broad audience, including researchers, academics, policymakers, environmentalists, and anyone interested in water-related issues. It serves as a valuable resource for those seeking a deeper understanding of the challenges and opportunities within the realm of water resources and environmental studies. By addressing a wide range of topics, we aim to engage and inform a diverse readership, enabling them to contribute to the global dialogue on water sustainability.

In this volume, each chapter explores critical facets of water and its multifaceted role in our environment.

2. Materials, Methods, and Results

As we delve into the pages of this Special Issue, we are met with a diverse collection of research articles that span a wide spectrum of topics within the realm of water, environment, and sustainability. The depth and breadth of the contributions showcased in this

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volume demonstrate the unwavering commitment of the global research community to understanding and addressing critical challenges related to water resources, environmental conservation, and sustainable practices.

The paper: Use of Water and Hygiene Products: A COVID-19 Investigation in Indonesia [43] investigates COVID-19's impact on hygiene and water use in Indonesia using online and national surveys. It reveals increased adherence to hygiene practices, specifically handwashing, and following health guidelines. This resulted in higher water and hygiene product consumption, unaffected by socio-economic factors. Respondents' COVID-19 perception and compliance with health guidelines drove these changes, with older individuals favoring handwashing and younger ones preferring hand sanitizer. The study also notes stagnant access to safe drinking water but a rise in bottled water consumption, posing challenges for SDG 6 targets. It underscores the importance of addressing COVID-19 perception to promote better hygiene practices and expresses concerns about increased water use, domestic pollution, and wastewater management during and after the pandemic. These findings can guide policymakers, researchers, and practitioners in public health and water management to achieve SDG 6 goals during and beyond the pandemic.

The paper: The Vital Roles of Parent Material in Driving Soil Substrates and Heavy Metals Availability in Arid Alkaline Regions: A Case Study from Egypt [44] addresses the understudied influence of diverse parent materials in arid alkaline regions, focusing on four types: fluvio-marine, Nile alluvial, lacustrine, and aeolian deposits. The investigation assesses their impact on soil properties like clay content, bulk density, pH, and available phosphorus (AP). Statistical tests and meta-regression models are employed to analyze the data. Notably, alluvial deposits exhibit significantly higher soil organic carbon (SOC) and total nitrogen content compared to other deposits. Additionally, aeolian deposits contain more iron (Fe), while alluvial deposits have elevated levels of zinc (Zn), manganese (Mn), and copper (Cu). Soil parent material is a key factor affecting Fe content, while bulk density influences Zn and Mn levels, and SOC drives Cu content. This research contributes valuable insights into understanding soil substrate dynamics and heavy metal availability, considering variables such as parent materials, pH, bulk density, and clay content.

The research entitled: Hybrid Optimization Algorithms of Firefly with GA and PSO for the Optimal Design of Water Distribution Networks [45] delves into innovative optimization techniques to enhance the design of water distribution networks, by combining Particle Swarm Optimization (FAPSO) and the Firefly Algorithm with Genetic Algorithm (FAGA), which has been introduced to enhance the efficiency of the conventional Firefly Algorithm for designing cost-effective water distribution networks. These models underwent rigorous testing and were applied to both established benchmark networks found in the literature and a real-world case study in El-Mostakbal City, Ismailia, Egypt. The performance assessment of these algorithms included evaluating cost-related metrics, function evaluations, computational time for 1000 evaluations, and a success rate determined using fuzzy logic for solutions slightly exceeding the known optimal solution (by approximately 1.0% and 2.0%). The results demonstrated that the FAGA model surpasses the standard Firefly and FAPSO models in terms of effectively exploring the search space, exploiting promising areas, and converging toward optimal solutions. This indicates FAGA's potential as a robust optimization technique for water distribution network management.

Regulatory measures, such as submerged vanes, are essential for mitigating and preventing environmental damage caused by increased river flooding. Elevated flow velocities can lead to erosive scouring on the outer riverbank, resulting in adverse changes to the riverbed. This paper: Experimental and Numerical Study on Flow Control Using 3-Array Submerged Vane in Laboratory Channel Bend [46] focused on investigating the impact of flow velocities in proximity to the outer bank through experimental testing using a 3-array submerged vane structure in an open channel setup. The results from the experimental vanes were verified and compared to Computational Fluid Dynamics (CFD) outcomes using a standard-based k-ε turbulence model. The CFD model closely approximated the real experimental results. In the outer meander, the three-array submerged vane with a

three-vane structure was found to reduce flow velocity by 16–27% in the vane's downstream area, with flow velocity decreasing by 14–21% along the depth. This study recommends the implementation of submerged vane structures as an effective approach to decrease flow velocities and guide water flows.

The concept of floating photovoltaic plants presents an innovative approach to address water evaporation issues while generating clean energy. A case study from Lake Nasser in Egypt illustrates the potential of this technology in water-stressed regions, as presented in Floating Photovoltaic Plants as an Effective Option to Reduce Water Evaporation in Water-Stressed Regions and Produce Electricity: A Case Study of Lake Nasser, Egypt [47]. This research aims to address two critical issues concerning water and energy while conserving these resources. The study proposes the use of floating photovoltaic (FPV) panels with partial coverage on Lake Nasser. Results reveal that partially covering Lake Nasser with FPV panels offers an effective solution for preserving Egypt's water resources, which are strained due to water scarcity. This approach significantly reduces water evaporation from Lake Nasser by 61.71% (equivalent to 9,074,081,000 m^3/year) and generates an annual electricity output of 467.99 TWh/year when 50% of the lake's area is equipped with FPV panels.

A green approach to wastewater treatment is explored in the paper: Simultaneous Removal of Metal Ions from Wastewater by a Greener Approach [48]. The research emphasizes the significance of sustainable and environmentally friendly methods for metal ion removal from contaminated water sources. Results indicated that higher initial metal ion concentrations led to increased adsorption capacity, but decreased the removal efficiency of *S. cerevisiae* yeast cells. The best results were achieved at specific conditions: pH 5.0, 2.0 g *S. cerevisiae*/L, 25 °C, and a 25-min contact time. The maximum adsorption capacities (qmax) for Pb(II), Cd(II), and Ni(II) ions were 65, 90, and 51 mg/g, respectively, as per the Langmuir model. The biosorption reactions for metal ions were spontaneous and followed the pseudo-second-order model. Mechanisms of metal ion removal were elucidated using XRD, FTIR, BET, and TEM analyses. Additionally, EDTA and citric acid proved effective in desorbing adsorbed ions. Storage experiments revealed that immobilized *S. cerevisiae* remained stable for up to 8 months, surpassing the raw yeast instability.

The World Health Organization (WHO) has endorsed the use of Water Safety Plans (WSPs) as a highly effective approach for enhancing water safety management since 2004. While the implementation of WSPs is gaining global traction, there remains a lack of a standardized methodology for conducting WSP verification. The paper: Long-Term Assessment of a Water Safety Plan (WSP) in Salta, Argentina [49] presents a comprehensive assessment of a specific WSP five years after its initial adoption. The study scrutinizes the risk assessment methodology utilized by a water utility in Salta, Argentina, and appraises the execution of control measures. To objectively gauge the WSP's effectiveness, water quality parameters and customer complaints are analyzed over time. The findings reveal that while certain control measures were put in place and risk values decreased, persistent issues in Salta's water supply, like customer complaints and high turbidity levels during the rainy season, remained unresolved. The article also emphasizes the role of rigorous scientific evaluations and the significance of legislative and regulatory bodies in WSP implementation.

Flash floods pose severe risks in arid regions. This case study entitled: Evaluation and Mitigation of Flash Flood Risks in Arid Regions: A Case Study of Wadi Sudr in Egypt [50] explores methods for evaluating and mitigating these risks, contributing to improved disaster management strategies. The research employs an integrated approach, combining the Geographic Information System (GIS) and the Watershed Modeling System (WMS) with HEC-HMS to analyze and visualize flood events in the area. Various geomorphological parameters of the watershed are determined, encompassing linear, areal, and relief characteristics. GIS is utilized to analyze satellite images, identify valley attributes, and delineate stream orders. WMS is employed to estimate rainstorms, basin features, and rainfall thresholds for flooding. HEC-HMS is used for hydrological modeling and flood

estimation. The analysis of morphometric and hydraulic parameters reveals that Wadi Sudr encompasses 4029 streams of the seventh order, covering an area of 547.45 km^2. The study identifies two potential dam locations for flood protection, with a comparison indicating that the first location is more suitable based on several criteria, including storage capacity, water depth, valley shape, and construction cost efficiency. The study uses the weighted linear combination (WLC) method to confirm the suitability of the first location. The proposed dam is expected to efficiently mitigate flood risks and enable water utilization for various purposes. This methodology holds potential for application in other areas facing flash flood hazards.

Urban rainstorm drainage systems play a vital role in managing water in urban environments. The research entitled Effect of Changing the Shape and Size of Inlet Area of Grates on the Hydraulic Efficiency of Urban Rainstorm Drainage Systems [51] examines the impact of changes to the inlet area of grates, enhancing our understanding of hydraulic efficiency in drainage systems. The study explores five distinct grate shapes and three relative inlet areas (26%, 51%, and 64%). The results indicate that the most efficient grate shape is type 4, with an 8.7% reduction in discharge efficiency. Altering the inlet area size from 26% to 64% significantly impacts the systems' efficiency, decreasing it by 4%. The study also utilizes dimensional analysis and multiple regression analysis to develop an empirical equation for calculating drainage system efficiency. The findings offer insights for decision-makers to optimize maintenance scheduling, potentially saving costs. The empirical equation aids in monitoring grate blockage and its impact on efficiency. This study's outcomes can inform future road drainage system construction, enhancing their effectiveness and reducing urban flood risks.

The final contribution to this Special Issue entitled Advances in Assessing the Reliability of Water Distribution Networks: A Bibliometric Analysis and Scoping [52] offers a comprehensive bibliometric analysis and scoping review, illuminating the latest advances in assessing the reliability of water distribution networks. Water Distribution Network (WDN) reliability is a crucial subject that has garnered increased attention over the past decade, with a growing body of research exploring various aspects of this field [53]. This study conducts a bibliometric analysis and scoping review to assess the progress and identify research gaps in WDN reliability. Three primary research themes are discerned: WDN optimization, reliability assessment, and the consideration of greenhouse gas (GHG) emissions and energy costs in WDN expansion. Reliability surrogate measures (RSMs) emerged as a heavily researched topic. Meanwhile, evaluating the performance of various RSMs and incorporating energy and cost considerations into WDN design and expansion are identified as emerging research trends in WDN reliability.

3. Conclusions and Perspectives

In conclusion, 'Water, Resources, and Resilience: Insights from Diverse Environmental Studies' brings together a rich tapestry of research contributions that collectively emphasize the paramount importance of water management and sustainability. As our global community faces escalating water challenges driven by climate change, population growth, and pollution, the need for innovative solutions and informed decision-making becomes increasingly urgent. This collection of studies provides a multifaceted exploration of water-related topics, ranging from the impacts of the COVID-19 pandemic on hygiene practices in Indonesia to the intricate geomorphological parameters affecting soil substrates in arid regions. The insights derived from these studies offer a mosaic of knowledge and strategies to address the complex and evolving water issues of our time.

One overarching theme that emerges is the necessity for interdisciplinary collaboration. Water resources touch upon a multitude of aspects, encompassing public health, environmental conservation, energy production, and infrastructure engineering. These studies reflect the interconnected nature of water, emphasizing the need for cooperative efforts among researchers, policymakers, and practitioners to develop holistic solutions [54–60].

The application of advanced technologies and analytical tools is a prevailing trend, aiding researchers in their quest to better understand, manage, and harness water resources. Computational modeling, data analysis, and geographic information systems have been instrumental in several of the studies, enabling precise assessments and simulations. In this regard, the incorporation of artificial intelligence (AI) presents an exciting avenue for future research. AI, with its ability to process vast datasets and derive meaningful insights, can enhance the precision and efficiency of water-related studies. Machine learning algorithms, for instance, can aid in predictive modeling for water quality, demand forecasting, and flood risk assessment [61].

Moreover, the findings underscore the importance of adaptable and environmentally friendly approaches. The utilization of submerged vanes to control river flows, the deployment of floating photovoltaic panels to mitigate water evaporation, and the exploration of greener methods for wastewater treatment exemplify sustainable practices that can serve as blueprints for the future. These sustainable strategies not only conserve precious resources but also align with global goals for mitigating climate change and protecting ecosystems [62].

The focus on water safety and the assessment of water distribution networks highlights the significance of clean and reliable water supplies for public health and urban resilience. As urban areas continue to expand, addressing the challenges of urban rainstorm drainage systems, with a spotlight on the efficiency of grates, is a vital concern. These studies offer valuable insights for urban planners and engineers striving to ensure cities can effectively manage rainfall and minimize flooding.

Finally, this collection of studies takes a significant step toward expanding our understanding of WDN reliability. In a world where water scarcity is a looming crisis, the assessment and optimization of water distribution networks play a pivotal role. The bibliography analysis and scoping review illuminate the research landscape and pave the way for future investigations. AI, with its data-driven capabilities, can revolutionize this field by optimizing WDN designs, predicting maintenance needs, and enhancing reliability through smart sensors and real-time monitoring [63].

In perspective, this comprehensive body of research encourages us to pursue sustainable water management practices, embrace technological innovations, and engage in interdisciplinary collaboration. AI, coupled with big data analytics, can play a pivotal role in these pursuits, offering the potential to revolutionize water resource management. By leveraging AI's capabilities, researchers can develop predictive models, optimize resource allocation, and enhance decision-making processes. AI-driven monitoring systems can provide real-time insights into water quality, usage patterns, and network vulnerabilities, thereby promoting resilience and sustainability [64–73].

As we stand at the threshold of a future where water scarcity threatens communities and ecosystems, the insights and methodologies presented in this collection provide a ray of hope. They serve as a reminder that, equipped with knowledge, innovation, and cooperation, we possess the means to address the water challenges of our time and safeguard this invaluable resource for future generations. This work exemplifies the collective commitment of the global research community to advance water resource management and contribute to the construction of a more sustainable and resilient world.

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