

Review

Global Water Initiatives Redux: A Fresh Look at the World of Water

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Abstract: The complex and globally influential mosaic of institutional frameworks, organizations, events, declarations, professional societies, organizations, and networks that focus on water-resources governance collectively known as “global water initiatives” (GWIs) remains starkly understudied. We address this knowledge gap by means of a robust examination of key actors and institutions involved in global water governance and thereby affirm the dynamic and organic nature of the GWI landscape. Our investigation of the changing landscape of GWIs taps historical and current data and employs both text analysis and bibliometric review. We find that: (1) GWIs have diversified, expanded their constituencies, and gradually extended their influence over how water is perceived, governed, and managed; (2) the institutional landscape within which GWIs exist and operate is continuously shifting to accommodate and lubricate the spread of new ideas, ways of thinking, and available science and tools; (3) networks, megaconferences and their declarations, and water-themed journals likely will continue to be at the leading edge of global water governance and policy; and (4) the advent of the Millennium Development Goals and Sustainable Development Goals has enhanced the relevance of UN-Water, the network of water-related United Nations (UN) agencies. Our findings indicate that as the number of GWIs grows, such proliferation has not necessarily led to duplication, but more likely to diversity and interconnectedness. On balance, GWI activity tends to increase awareness-raising, information-sharing, network-building, agenda-setting, and on-the-ground action. GWI behavior both mirrors and influences prevailing worldviews on water governance and management and taken together, GWI efforts continue to shape international water discourse.

Keywords: global water governance; water policy; water institutions; water megaconferences; SDGs; water declarations; global water initiatives



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1. Introduction

Global water initiatives (GWIs) can be seen as “institutional frameworks, organizations, and special events that focus on water resources management” [1]. Within the realm of water governance, “GWIs are a global constellation of goals, interests, topics, specialties, and expertise” [2]. In a chapter appearing in the volume, *Impacts of Megaconferences on the Water Sector* [3], we provided the following working definition:

GWIs are institutions whose fundamental purpose is to advance the knowledge base regarding the world's inland water and its management. Additionally, since the 1980s, the core aim of many GWIs has expanded to include an active social and policy component. Thus, the mandate of many of these initiatives now includes attempts to improve access to potable water and sanitation across the globe.

Those complementary definitions, taken together, encompass the full continuum of organizations, associations, programs, networks, events, and consciousness-raising efforts that, each in its own way, is attempting to enhance what some have called “the world of water [4]”.

Why should water professionals, water scholars, water users, and other stakeholders care about the collection of institutions known as global water initiatives? Many of those individuals remain unaware of their objectives, functions, accomplishments, and even their existence. In this essay, while recognizing the limitations of GWIs, we explain and illustrate that they can offer tangible services in multiple ways. For example, at a global scale: GWIs foster expertise in and offer venues for basic and applied research; provide important forums that encourage discussion, information exchange, and international cooperation; raise awareness of major water-related issues and problems; promulgate new development-oriented paradigms; promote, publicize, and disseminate promising new ideas and potential real-world solutions; and help stimulate large-scale investments in infrastructure and governance. Over recent decades, GWIs increasingly have included diverse voices such as those of environmentalists, water users, women’s rights advocates, community leaders, industrial and agricultural interests, and indigenous and other minority groups. The resulting amenities have become available to diplomats, policymakers, practitioners, community organizers, academics, and others with water-related interests.

To gauge how the world of water has evolved, we revisit our research team’s earlier study of GWIs and reassess the status and influence of these initiatives. The original work by researcher Robert Varady began at the end of the 1990s and culminated in essays published between 2003 and 2014. The current work offers a fresh look at GWIs over the past two decades with a focus on the changing institutional landscape, the rise and ebb of certain groups of GWIs, and the ascent of newly influential water networks and conference-based declarations.

We begin with some historical context to establish the antecedents and genesis of this work. Then, we review our findings from our previous GWI research, highlighting eight key themes from the original work. This permits us to pursue our stated “*redux*” goal, that is, to survey the modern terrain of GWIs.

We adopt a number of methods to explore the modern world of GWIs. First, to chart the current state of GWIs for comparison to the earlier situation, we searched for each type of initiative and *compiled comprehensive, updated listings* to allow us to discern trends in individual and collective GWI growth patterns. Next, we conducted a *text and content analysis of international water declarations* to reveal changing concepts over time by examining the shifting vocabulary and priorities of these influential instruments. Then, we undertook a *bibliometric evaluation of the role of water-themed professional journals* within the broader GWI landscape. Finally, to remain within the mainstream of scholarship, we *consulted and referred to the relevant body of literature* on global water governance. To help visualize our findings, *we crafted an extensive set of figures and tables*. Together, these techniques allowed us to capture the evolving nature of GWIs.

Overall, our findings suggest that: (1) GWIs have diversified, expanded their constituencies, and gradually extended their influence over how water is perceived, governed, and managed; (2) the institutional landscape within which GWIs exist and operate is continuously shifting to accommodate and lubricate the spread of new ideas, ways of thinking, and available science and tools; (3) networks, megaconferences and their declarations, and water-themed journals likely will continue to be at the leading edge of global water governance and policy; and (4) the advent of the Millennium Development Goals and Sustainable Development Goals has enhanced the relevance of UN-Water, the network of water-related UN agencies.

2. A Review of GWI Antecedents and Genesis

Robert Varady’s earliest exposure to such global initiatives was in 1999, upon interacting with his colleague, the distinguished University of Arizona hydrometeorologist W.

James Shuttleworth (1945–2020). Shuttleworth, whose career was signally sparked and motivated by the 1965–1974 UN International Hydrological Decade (IHD), believed it was time to reawaken interest in the state of the planet’s water. Determined to convince his fellow water scientists, Shuttleworth [5] published an article in *Eos* titled, “New worldwide hydrological initiative needed”. In it, he advocated for “a new, decade-long worldwide hydrological initiative to permit change in the paradigm that underlies hydrological design and management” [5]. That same year, in coordination with UNESCO hydrologist Michael Bonell (1943–2014), Shuttleworth organized a conference in Tucson, Arizona. Still aiming to promote the adoption of a new awareness-raising decade, the two channeled this idea into a new effort, the HELP (Hydrology for the Environment, Life and Policy) Initiative. The conference drew about a hundred water scientists and practitioners. While it did not yield Shuttleworth’s hoped-for decade, it did create one of the first major global attempts to integrate the disparate aspects of freshwater management. The resulting catchment-based HELP Initiative sought to broaden discourse on water by addressing five key aspects of water management: water and climate, food, quality and human health, environment, and conflict. Once endorsed, HELP was hosted and supported by the United Nations Educational, Scientific and Cultural Organization (UNESCO)’s Intergovernmental Hydrological Programme (IHP), the permanent successor to the International Hydrological Decade [6–8]. (Note: Until November 2019, IHP was called the International Hydrological Programme. “International” was replaced to indicate IHP’s intergovernmental nature.)

By 2000 the HELP concept crystallized into a working entity. It mobilized by inviting basins from around the world to join the initiative. Varady was drawn in, representing the transboundary (U.S.-Mexico) Upper San Pedro basin and participating in steering the program. Soon he was attending conferences in Europe, Latin America, and Asia, reflecting on how the San Pedro basin fit HELP’s five pillars and comparing notes with participants from some five dozen basins. In 2002, via the HELP network, Varady learned of another emerging global initiative, this one focused on the first of HELP’s five themes, climate. With climate change a rising concern, especially in lowland nations like The Netherlands, the Dutch government determined to “bring the water resources management community and the climate science community closer together [9]”. The Dutch foreign ministry’s Delft-based Institute for Water Education (IHE) initiated the “Dialogue on Water and Climate” (DWC). That program sought to promote its vision within distinct geographical areas: basins, nations, and subcontinental regions. The binational San Pedro basin fit this construct, and Varady’s team was among 17 such groups invited to join the “dialogue”. The project entailed a concerted effort to engage water professionals (decisionmakers, planners, managers, researchers, and users with climate professionals (disaster managers, climatologists, and other stakeholders)—via science-policy dialogues and surveys. At global forums, Varady and his colleagues again compared experiences and exchanged ideas with their analogues from remote basins such as the Thukela in South Africa, the Lena in Russia, and the Aral Sea in Central Asia.

At the 2003 Kyoto World Water Forum (WWF), the HELP Initiative and the Dialogue on Water and Climate were both prominently represented. The San Pedro basin, which met the aims of both programs, was showcased by each. The WWF provided an even larger, global assembly for discussing the spectrum of water-management issues. There, the realization arose that this suite of efforts—a major UN-designated decade (IHD), a UNESCO program (IHP), two specific initiatives (HELP and DWC), and a large thematic gathering (WWF)—were part of what was clearly a larger phenomenon. In subsequent conversations, Shuttleworth traced the origin of all these developments to the seminal IHD. At that point, Varady determined to study the evolution of the process.

The initial question was, what—if anything other than the words “hydrology” or “water”—did the IHD, IHP, HELP, DWC, and WWF have in common? Certainly, they each fit the definition of a water-related institution. One of them, HELP, called itself an “initiative”, that is, “a new plan or action to improve something or solve a problem” (Cambridge Business English Dictionary). In that sense, each of the above five institutions

fit that definition. Each came into being to confront an issue or set of issues: the planet's water budget (IHD), the stimulation and encouragement of hydrological research and knowledge (IHP), the relationship of hydrology to society and the environment (HELP), the role of climate in water management (DWC), and enhancement of awareness of salient water issues (WWFs). Each could be considered an initiative. Moreover, three of the five initiatives included the word "international" or "global", while the other two (HELP and DWC), via their multiple sites, covered the globe.

More specifically, these early 2000s explorations considered the trajectories, actions, and impacts of the following types of GWIs: (1) professional societies addressing various aspects of water and hydrological science, (2) special events such as megaconferences [10,11], (3) designated time periods created to call attention to water-related themes, and (4) established organizations with well-defined missions.

3. Early Findings of GWI Studies

In 2008, we argued that the global phenomenon of GWIs was a useful way to characterize the various modes for addressing issues relating to water research, management, and governance. We also noted that the GWI framework had been "infrequently studied and poorly understood" [2]. A review of the literature since then shows that this observation remains on the mark a decade-and-a-half later. Remarkably, a Google search of "what is a global water initiative?" and of the more general, "global water initiatives" yielded zero hits other than references to work by the Varady team. A Google Scholar search of "global water initiatives" yielded the same result. (See Appendix A for a list of GWIs by type). This is not to say that scholars have failed to consider such questions, especially those concerning water governance (that may involve a subset of global water initiatives) at the global scale. On the contrary, the literature of the past few decades is replete with rich theoretical and applied studies by such writers as Allan [12], Bakker [13], Biswas and Tortajada [14], Brooks [15], Conca and Weinthal [16], Gupta [17], (Pahl-Wostl [18], Heikkila and Gerlak [19], Hoekstra [20], Molle [21], Mukhtarov [22], Pahl-Wostl [23], Rogers and Hall [24], and Young [25] to name just a very few of the authorities who have addressed the topic.

Other studies have touched on specific types of GWIs, such as conferences (e.g., Biswas and Tortajada [14]) or organizations (e.g., Baumgartner and Pahl-Wostl [26]), however none assess the landscape of GWIs as a whole. They and others have viewed global water governance—understood by us most broadly in a variety of ways, via diverse disciplines and methodologies—*just not through the explicit prism of GWIs*. Pahl-Wostl [18] defines global water governance rather tightly as "the development and implementation of norms, principles, rules, incentives, informative tools, and infrastructure to promote a change in the behavior of actors at the global level in the area of water governance". Araral and Wang [27] and Tropp [28] offer a suite of excellent examples of alternative definitions of the term, most of which emphasize such flexible, bottom-up characteristics as networking, partnerships, transparency, multiple perspectives, informality, inclusivity, adaptive capacity, and sustainability. In accepting a broad definition, we are mindful of a caution by Woodhouse and Muller [29] that "the narrative of 'global' water governance has little purchase on the actual practice of water management".

Before portraying and reflecting on the current state of GWIs, we review and highlight eight take-away findings from our GWI research conducted between 2003 and 2014:

- The water discourse has been directly influenced by larger, prevailing global political patterns.
- The first GWIs arose among 19th century water professionals.
- Special events have contributed appreciably to thinking about water.
- The idea of designating specified time periods to draw attention to particular water topics has continued to be a common strategy.
- Organizations, especially intergovernmental and nongovernmental ones, have been key vehicles for promoting ideas and strategies.

- Excessive proliferation and overlap of GWIs has been a persistent locus of criticism, but much of this concern is attributable to a misunderstanding of how institutions occupy particular spaces.
- Another source of skepticism is the indisputable difficulty of gauging the effectiveness of GWIs.
- GWIs, while eluding simple measures of efficacy, have nonetheless advanced global thinking about water problems and their solutions.

These findings, discussed more fully below, offer a baseline from which we proceed look at how things have changed. A list of GWIs by type is in Appendix A.

3.1. Global Political Patterns Have Shaped the Water Discourse

The ways freshwater has been understood since the late 19th century reflect prevailing political thinking. Among colonial powers, centralized control of the economy and of revenue was of paramount concern. Accordingly, those issues regarding water that arose were about such concerns as assuring navigation, improving and extending irrigation, tackling waterborne disease, and implementing land reclamation. This type of state-led development and accompanying centralized decision making continued well into the 1970s and even the 1980s.

Accordingly, the post-World War II years favored large investments in water infrastructure such as dams, treatment plants, and water diversion schemes. Then, by the mid-1970s neoliberal, free-market economic models began to gain acceptance. In the non-communist world, this retreat of the state led to sharply reduced spending for social programs and public works, with generally negative impact on water management. However, austere policies also spawned the building of multilateral and global institutions, abetting the rising prominence of the nongovernmental (NGO) sector [22]. One result was the advent of new ways of thinking about development. Sustainability, public participation, transparency, and decentralization began to penetrate global development practices [30]. In the world of water, these new paradigms yielded new, more decentralized and integrated approaches to water management.

3.2. The Earliest GWIs: Professional Meetings and Societies

The roots of professional meetings and societies as GWIs emerged in the mid-19th century. The earliest were organized meetings, as exemplified by the first International Sanitary Conference, held in Paris in 1851, and then the first International Meteorological Conference in Brussels in 1853. Similar events were convened over the following years and one, in 1885, led to the formation of the first water-related professional society, the International Navigation Association [31].

These associations were fashioned after the various branches of Britain's Royal Society. Their main purpose, from the start, was to promote science, form common intellectual spaces, share expertise and information among members, and promote research. Some were configured around important contemporary themes such as navigation. Additionally, perhaps anticipating the Titanic's 1912 encounter with a glacier, in 1894 scientists created the International Glacier Commission. Next, the all-encompassing International Union of Geodesy and Geophysics (created in 1919) began dividing into disciplines and then subdisciplines—hydrology (International Association of Hydrological Sciences; 1922), hydraulics (International Association for Hydraulic Research; 1935), limnology (International Association of Theoretical and Applied Limnology; 1922), and groundwater hydrology (International Association of Hydrogeologists; 1964). More applied and general societies included the American Water Works Association (1881), World Irrigation and Drainage Congresses (1951), International Water Resources Association (1973), and International Water Association (1995).

At the time of our original research, about 40 such professional societies existed. Of those, 70 percent had come into being by 1980, and all but a half-dozen by 1999. Associations of this type predated and presaged other types of GWIs and "the role of

professional societies in the dissemination of water resources research information” was recognized early on by water researchers, as attested to by an article of that exact title published in 1973 by D. C. Taylor [32]. These organizations lubricate the spread of scientific and technical ideas by enabling researchers to make contacts and boost their skills [33]. *Nearly all of those societies have continued to function. They have represented the vanguard of the global water initiative evolutionary process.*

3.3. Influence and Significance of Special Events

It was events, like those 1850s conferences, that spawned professional societies. For much of the 20th century, these were mostly periodic membership gatherings. Those meetings eventually morphed into topical and thematic gatherings—that is, what we call “special events”. Such events began proliferating extensively in the 1970s, their themes often following and paralleling the shifting trends in the larger political discourse.

In the realm of water, these sorts of events began with the environment-themed 1972 United Nations Conference on the Human Environment [34]. The first solely water-focused event was the pioneering 1977 UN Conference on Water, known as the Mar del Plata conference [35–37]. Since then, scores of such gatherings—the most prominent of which have been the nine World Water Forums—have been at locations on every continent. They have been instrumental in convening attendees drawn from multiple sectors and diverse locations, representing different backgrounds, and bringing a diverse assortment of ideas about how water should be managed and governed. *The accumulated impact of these events has vetted and drawn attention to salient issues, and as importantly, as we will see below, produced a rich repository of declarations and action plans.*

3.4. Awareness-Raising by Designated Time Periods

Complementing the awareness-raising capability of special events have been a series of designated time periods, each intended to raise global consciousness of selected water-related concerns. Within the larger realm of earth science, the first such designated time period was likely the International Polar Year (IPY), first proposed in 1875 and put into effect in 1882–1883 by the International Meteorological Organization. The goal of the IPY was to “address geophysical phenomena beyond the capabilities of any single nation” [38]. The IPY inspired the 1957–1958 International Geophysical Year [39], which U.S. President Dwight Eisenhower called “one of the great scientific adventures of our time” [40]. At the height of the Cold War, IGY served a key diplomatic purpose: it brought together geoscientists—including hydrologists from the Soviet Union and the rest of the world—in a common quest to understand geophysical processes affecting the planet.

Fifteen years later, water scientists prevailed upon the UN to organize a water-themed analogue to IGY. This time an entire decade was allocated: the 1965–1974 International Hydrological Decade (IHD), which also harnessed science to bridge political disagreements. By the end of the IHD, the wisdom of setting aside time periods in the service of advancing social and scientific progress was well accepted. At the time of our earlier research, five such periods—ranging from a single day (World Water Day) to a full ten years (“Water For Life Decade”) had been declared—the others being the International Drinking Water Supply and Sanitation Decade (1981–1990); World Water Day (annually since 1993); International Year of Sanitation (1998); International Year of Freshwater (2003); International Decade for Action, “Water for Life” (2005–2015).

A 2004–2005 survey asked 120 international water experts to rate the influence of these time periods [3]. The IHD was quite highly regarded (ranking eighth highest among 30 GWIs of all types), the International Year of Freshwater considerably less so (16th), and the International Drinking Water Supply and Sanitation Decade even less so (23rd). *Although there exist no reliable metrics for measuring the actual impact of these periods, they continue to be created, each one highlighting a theme targeted for action. Their persistence suggests that these special days, years, and decades have supplemented the work of other GWIs to focus attention and educate the public.*

3.5. The Contribution of Organizations

Our original work considered intergovernmental and nongovernmental organizations (IGOs and NGOs) as GWIs. Among intergovernmental groups, from the start the most active and prominent were UN agencies and their spawns. At the close of the IHD, there was a strong consensus that the work of that initiative should continue in permanence. The result was the establishment of the International Hydrological Programme (IHP), whose management was initially entrusted to two UN agencies, UNESCO and WMO (World Meteorological Organization). Over the years, other UN agencies with important water programs became active GWIs.

Beginning in the late 1990s, responding to the new modes of thinking about water, other global-water-centric organizations were forming. Chief among these were the World Water Council (WWC)—the conveners and organizers of the World Water Forums—and the Global Water Partnership—an institution with an on-the-ground water-management orientation. Both were created in 1996, and both received generous funding from the World Bank and other large donors. The 1990s also saw the formation of numerous NGOs, responding to new a emphasis on freshwater. Some examples include Living Water International (1990), Water Step (1995), Water Mission (1995), GlobalAid Water For Life (1998), and Pure Water For the World (1999). (See Appendices A and B).

The respondents to our 2004-05 survey rated IHP extremely highly (2.4) on a scale of 1 to 5 (with 1 as most effective), while WWC (2.8) and GWP (3.0) were considered moderately influential. *These intergovernmental and nongovernmental organizations pursued defined missions and disposed of budgets. They were able to organize conferences and programs, produce reports and technical papers, and in some cases, work directly on projects. While the record is mixed, it is reasonable to conclude that they have been a key component of the GWI experience.*

3.6. Proliferation and Overlap

The number of professional societies, special events, designated time periods, and organizations grew throughout the 20th century, accelerating in the last two decades. Was this proliferation excessive? Additionally, did it result in unnecessary and wasteful duplication of effort?

We have reported that two-thirds of some 30 respondents expressed concern about both of those issues [3]. They worried that insufficient cooperation, collaboration, and coordination of activities—even as new initiatives joined existing ones—was leading to duplication of programs, which in turn could yield such distractions as confusion, disorder, added complexity, and unnecessary effort. However, was that concern entirely justified?

We saw the burst of new GWIs as an example of “institutional diversity”—rather than as a race by many to achieve a single purpose [10]. Viewed in this light, governing the world’s water is an enormous and complicated task that is susceptible to being facilitated by the participation of multiple institutions, addressing different aspects of the challenge, via different strategies and niches. We saw that each GWI typically allocated to itself a primary scope and a specific program orientation. To illustrate, we considered five prominent types of scope—disciplinary, geographic, socially oriented, temporal, and thematic—and six common programmatic orientations—basic research, applied research, idea/concept-generation, management and administration, monitoring and evaluation, and policymaking. Employing conceptual polygonal spider diagrams, we showed that each GWI tends to exhibit a unique profile, or put another way, occupy a space unto itself. This is not to say that aspects of the proliferation dilemma do not persist.

3.7. Benchmarks, Metrics, and Quantification of Effectiveness

During the formative period of GWIs, the global water sector was dominated by hydrologists, hydraulic engineers, and other physical scientists. In the 1970s, as neoliberal and structural adjustment paradigms began to gain prominence, economists joined scientists and engineers as the most visible participants in the world of water. Practitioners of the two sets of approaches had one major ideal in common: they were highly reliant on measuring

impact—respectively, to better steer the science and to calibrate cost–benefit models. *But few knew how to quantify the success of such nebulous activities as convening professional meetings, organizing large gatherings, declaring special awareness-raising periods, or operating multinational IGOs and NGOs. And if such techniques were known, resources and willingness to undertake such evaluations were lacking. As a result, our early studies found little evidence of benchmarking or quantified analysis of GWI effectiveness.*

3.8. Overall Impact

Lacking universal methods for assessing success, it follows that determining overall impact remained largely impressionistic and subject to individual tendencies and preferences. Nevertheless, when we asked knowledgeable observers to rate the aggregate influence and success of GWIs, in spite of their concerns about overlap and proliferation, half of the 30 respondents expressed positive or at least partially positive opinions.

Still, there remained a sense of ambivalence and skepticism, best captured by Shuttleworth, “Certainly GWIs have had very substantial results in terms of scientific understanding and some socioeconomic benefits, [but] the transition of this understanding into practical benefit in individual catchments has been less successful [5]”. *And pairing this uncertainty with the above-noted lack of reliable measurability, some observers found that even as the popularity and legitimacy of such programs were cresting, their effectiveness remained relative, unmeasured, and not always evident [41–43].*

4. Discussion: Surveying the Landscape: A Renewed Look at the Universe of GWIs

The decade-and-a-half-plus since our original work has seen a number of important changes. Nevertheless, several of our previous observations about the role GWIs play in the global conversation about water appear to remain valid. To test that hypothesis, we set aside some previous notions of what constitutes the universe of discourse within which GWIs exist and reimagined how this space might appear now. Then, having enlarged our view, we searched and examined the literature, scoured the Internet for GWI home pages, and attempted to analyze the content of some of the textual record in order to reconstruct the whole of the GWI panorama. We expanded the numbers of constituents in each grouping and dug deeper into their origins, while populating several previously unconsidered but important GWI categories, such as networks and declarations, and associated activities that are a product of GWI operations, such as publications. We were especially interested in how and to what degree the landscape had changed over time. Which GWIs had become more prominent, and which had maintained a more-or-less steady-state existence?

4.1. What Remains More or Less Still True?

At the outset, we noted that the behavior of GWIs—especially newly created ones—continues to be a function of prevailing worldviews on water governance and management. We also determined that the four chief types of GWIs (professional societies, designated time periods, events, and organizations) identified in our earlier studies still exist and some have even proliferated.

Yet, as before, each type of GWI continues to occupy a unique intellectual and action-oriented space. To visualize this, we again constructed polygons to illustrate the priorities of six types of GWIs, adding in new two observed types. Such polygons can have any finite number of vertices and axes, where each one represents a possible objective of the institution under examination. For the spider diagrams in Figure 1, we have selected six representative objectives that depict the programmatic orientation of each GWI type: idea generation, research, policymaking, action, communication, and awareness-raising. Certainly, other choices exist—for example, attention to specific sectors such as agriculture or environment, promotion of legal arrangements, or advancement of technology. We chose the ones we did because they likely represent the most common objectives of GWIs.

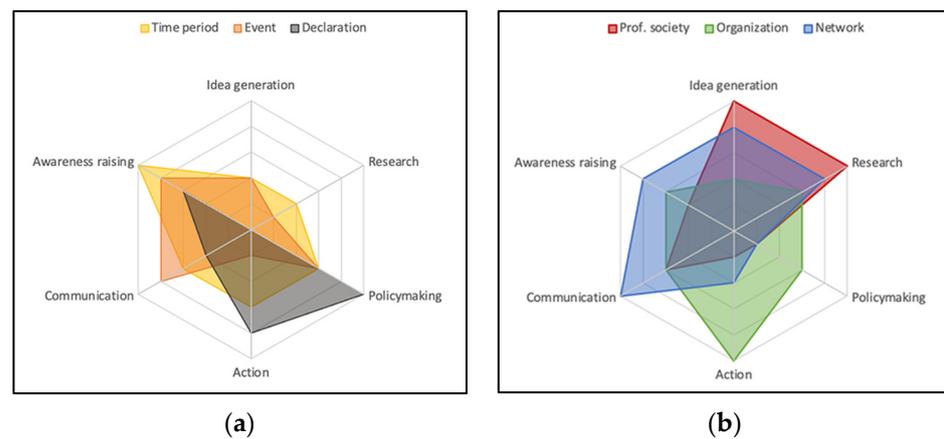


Figure 1. Spatial profiles of programmatic orientation (a) Spatial profiles of time periods, events and declarations; (b) Spatial profiles of professional societies, organizations and networks. Note: All figures and tables in this essay are by the authors.

On the resulting hexagons, each axis indicates the degree of commitment to the stated objective as assessed by the authors, with the highest value at the vertex. The diagrams show that the occupied spaces are markedly different for each type of GWI. Here, we note that adding vertices (i.e., objectives) would have the effect of making the resulting spaces even more unique to each type of GWI. This suggests that even as the number of GWIs grows, such proliferation does not necessarily lead to duplication. The question remains, as we asked in 2009, “when do the activities and sheer number of GWIs result in a cacophony rather than a concord of institutional resources, time, and efforts?”

Another factor that appears to remain unchanged is that the actions of GWIs have continued to defy attempts to measure their effectiveness and impact. In a recent essay [44], we asked whether water security—a related and equally elusive concept—can be quantified and measured? We uncovered some attempts to create a robust water-security assessment tool. However, in the end, we determined that, “Although visually quite attractive, careful examination of the underlying datasets often reveals unresolved problems of data provenance, quality, structure, and therefore commensurability” [44]. Additionally, given *the near total absence of scholarship on GWIs*, it is reasonable to conclude that quantitative assessments of aspects of GWI performance have similarly eluded the scientists, engineers, economists, and potential donors who rely on such metrics.

4.2. What Has Changed in the World of GWIs?

As we turn to the question of how the universe of GWIs has evolved, we find that *grosso modo*, the situation may look broadly familiar. However, a close look at the adjustments and changes reveals some important and potentially significant transformations. These include (1) the prominence of newly emerged and previously unconsidered types of initiatives within the ensemble of GWIs, (2) the notable increase in the number of some, but not all, kinds of GWIs, (3) the penetration and influence of some initiatives, and (4) the growing involvement of UN-Water alongside the advent of the UN’s Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs).

4.2.1. The Evolving GWI Landscape

In the early 2000s we identified four major types of initiatives: professional societies, special events, designated time periods, and organizations. Figure 2 shows a simple conceptual diagram of the four groupings within a universe of discourse.

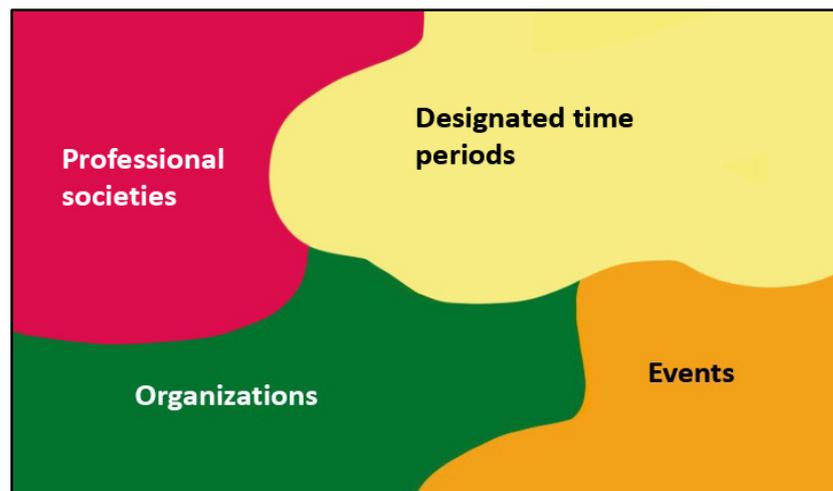


Figure 2. The GWI universe as conceived by authors in 2008. Note that the sizes and shapes are illustrative and notional only.

In the time since that imagined depiction, we have seen the rising significance of multiple new types of GWIs and associated activities. One of these types, *networks*, can be understood as a natural outgrowth of increased personal contact from activities of the four original categories shown in Figure 2. At the global or transnational scale, as Reinike recognized in 1999 [45], these GWIs function as “global public policy networks” and as an important conduit for the spread of policy in the realm of global governance [46]. They serve as the vehicles that help develop, channel, and transmit ideas about how to govern water “across space in a messy transnational fashion [47]”. We will see that global water networks merit further attention, having grown prodigiously over the past 15 years.

The second newly considered type of GWI, *declarations and statements*, is the direct outcome of special events. These sorts of instruments were always present, but because there were far fewer events, they were not nearly as numerous or as influential. Like networks, these GWIs have multiplied appreciably, more than doubling in the past decade-and-a-half. We have added these to the GWI schema and will analyze their content. Finally, the new landscape shown in Figure 3 includes *water-themed publications*, an outgrowth of GWI activities.

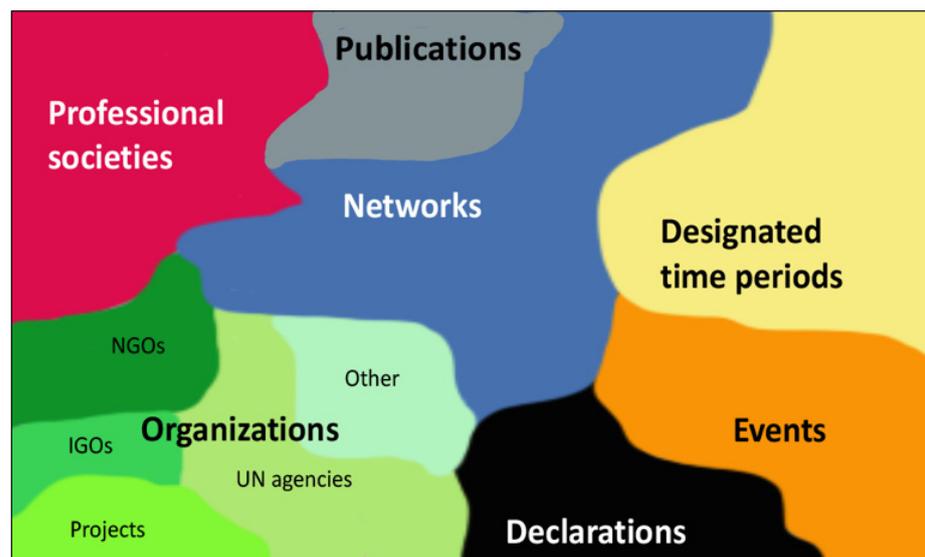


Figure 3. GWI universe as conceived by authors. Note: As above, sizes and shapes are illustrative and notional only.

Adding networks, declarations, and publications yields Figure 3, the GWI universe as we currently imagine it. Figure 3, along with the spider diagrams of Figure 1, show clearly that these additional types of GWIs add to the overall reach of the collection of initiatives. Networks extend the degree of commitment along four of the axes—communication, awareness-raising, idea generation, and research. Declarations do so along two axes—action and policymaking. Additionally, publications extend to all six vertices.

On close examination, we see that organizations are of several distinct types: UN agencies, IGOs, NGOs, and other—including private-sector institutions, national donor agencies, and religious and charitable organizations. These organizations also frequently design, operate, and fund on-the-ground projects and studies.

A glance at Figures 2 and 3 might suggest that the GWIs that comprise the universe have fixed boundaries and do not overlap. Figure 4—which includes the newly considered networks and declarations—corrects this view, showing clearly in Venn diagram style, that there is broad overlap of institutional scope and focus among all types of initiatives.

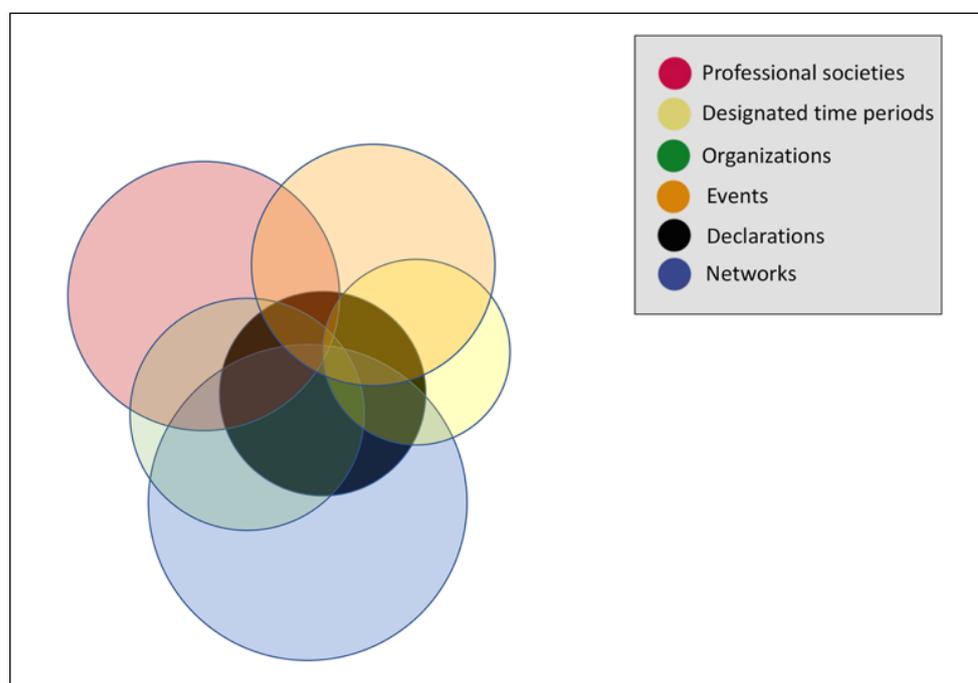


Figure 4. GWI universe, showing overlap of initiatives. Note: As above, the sizes are illustrative and notional only.

A different way of representing this institutional overlap is via a timeline. Figure 5 shows the progression by decade of selected, newly introduced GWIs, beginning with the oldest ones in the 1880s through the newest ones at the present.

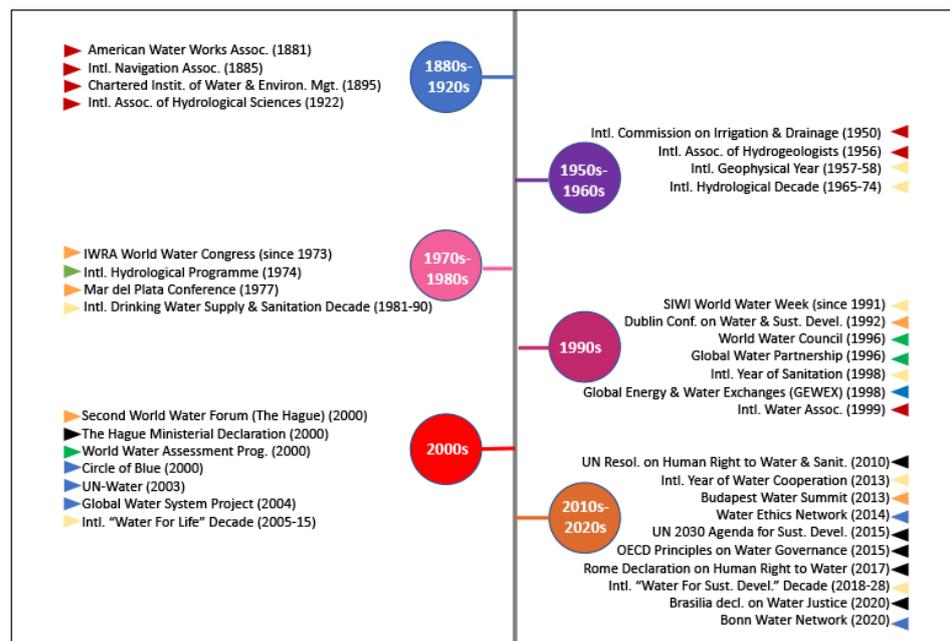


Figure 5. Timeline of GWIs, 1880s to 2020s. Note that the colors of the triangles correspond to the colors of the types of GWIs used throughout this essay.

The overlap illustrated in Figure 4 is not solely institutional. Each type of GWI is populated by members, participants, attendees, subscribers, readers, learners, and others benefiting from the activities of these institutions. At a more granular level, Figure 6 illustrates schematically that individual members and participants also overlap, some by belonging to or being active in multiple GWIs. This sort of intersection amplifies GWI objectives, particularly about awareness-raising, information-sharing, agenda-setting, and action orientation. Water scholar Malin Falkenmark [43], summarizing the impact of the first ten annual Stockholm Water Symposia, highlighted the connection between the events, their attendees, the networks within which they operate, their strategic actions, and the changes they were able to effect in addressing global water issues.

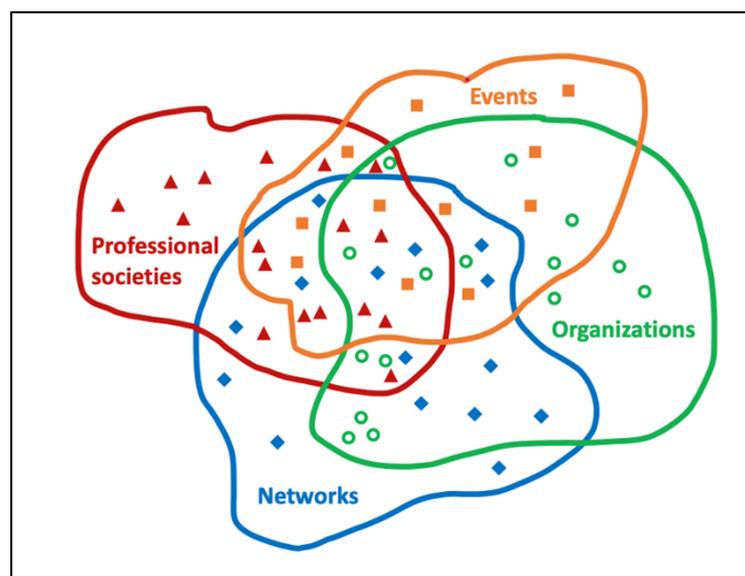


Figure 6. Participation and membership in GWIs. Note: the circles, diamonds, squares, and triangles represent participants in organizations, networks, events, and professional societies, respectively.

With this expanded conception of the GWI landscape, we turn to what we see as the other most striking substantive changes. The first of those is the emergence of new water-management framings.

4.2.2. Following the *Zeitgeist*: New Framings for Water Management

As noted, by the early 1990s global thinking began to undergo a gradual transformation away from centralized, state-led, supply-side, public-works infrastructure-dominated development to a more open and sustainability-conscious mode [22]. Since then, framings have included such underpinnings as emphasis on soft-path and demand-side approaches [15]; adoption of integrated water resources management (IWRM) techniques and practices [24,48]; attention to water, sanitation, and hygiene [49]; recognition of the nexus between water, energy, and food [50]; acknowledgment of social and environmental justice, in the form of water security [51]; and rising emphasis on hydrodiplomacy, especially with regard to transboundary issues [52–55]. All of those framings draw on rich literatures and lively debates.

There is no clearer indicator of this broadening trend than the annual themes of World Water Day (WWD). Since 1994, the UN has set aside 22 March to draw the world's attention to water [56]. The day itself is an event as well as a designated time period, since it is commemorated at hundreds of sites across the globe, in workshops and forums at government offices, university campuses, school auditoriums, and theaters. Each year, WWD highlights an aspect of water to serve as a focal point for drawing media attention and raising public consciousness. A glance at some selected topics reveals how the tenor of global discourse on water is evolving from its early hard-path framings. (For more on hard-path and soft-path framings, see Lovins [57], Haas [58], Conca [59], Brooks [15], Varady et al. [60].) The 29 WWDs have featured such timely themes as: *Climate* ("Water and Climate Change"); *Cooperation* ("International Year of Water Cooperation"); *Economics* ("Valuing Water"); *Environment* ("Nature for Water"); *Equity* ("Leaving No One Behind"); *Gender* ("Women and Water"); *Groundwater* ("Making the Invisible Visible"); *Hydrodiplomacy* ("Transboundary Waters"); *Labor* ("Better Water, Better Jobs"); *Universality* ("Caring for our Water Resources is Everybody's Business"); and *Urban* ("Water for Thirsty Cities"). As the UN has homed in on the SDGs, the activities spawned by the annual WWDs "have helped support the achievement of SDG 6: water and sanitation for all by 2030" [56]. (A list of GWIs by type may be found in Appendix A; a list of UN-Water organizations can be found in Appendix B.)

4.2.3. Uneven Growth Trends

To survey the current state of GWIs in order to compare it to the earlier situation, we looked for each type of initiative and compiled reasonably complete listings. Extensive searching via Google, other search engines, and the extant literature yielded a very large set of institutions that fit the definitions of the six types of initiatives we are examining. We also identified UN-Water's constituent agencies, partners with special status, and partners; international water assessments; and water-related academic journals. While it's not possible to claim that all these listings are exhaustive, we believe that they may be nearly so.

These listings allow us to discern trends in individual and collective GWI growth patterns. We found that the trends are not uniform. Some GWIs—most evidently professional societies, and to a lesser degree events, time periods, and NGOs—seem to have attained a steady-state equilibrium. Nearly all (83 percent) professional societies were formed prior to the present century. By contrast, networks and declarations, which we have added to our current study, have proliferated at a pronounced rate, growing by 150 and 156 percent since 2007, respectively.

Table 1 and Figures 7–9, along with Appendices A and B, show numerically, graphically, and in listings that GWI growth patterns have been uneven. Networks and declarations are now the fastest-multiplying GWIs. When comparing the growth rates of the other

four types of GWIs during the 1992–2006 years to those of 2007–2021, Table 1 shows that all four rates have declined. Additionally, in the 2007–2021 period, professional societies appear to have attained some constancy, with only six of 38 having formed in the present century. Table 1 and the figures confirm that over the past decade and a half, the rise in numbers of water-related NGOs—which surged in the 1990s and 2000s—also has slowed, having peaked (as Figures 8 and 9 show) in the 2000s. Over this same 15-year stretch, designated time periods and events have grown at about equal annual rates, with about one new one added every three to four years. This rate of growth has permitted them, by and large, to maintain their missions and constituencies.

Table 1. Growth of GWIs, 1992–2006 and 2007–2021.

Type of GWI	Total Number 1885–2021	Number (#/y) 1992–2006 (15 Years)	Number (#/y) 2007–2021 (15 Years)	Pct. Growth 2007–2021 (1885–2006)
Networks	40	13 (0.87)	24 (1.60)	150
Declarations	65	19 (1.27)	38 (2.53)	141
NGOs	33	16 (1.07)	11 (0.73)	50
Time periods	10	4 (0.27)	3 (0.20)	43
Events	14	6 (0.40)	4 (0.27)	40
Professional societies	38	7 (0.47)	2 (0.13)	6

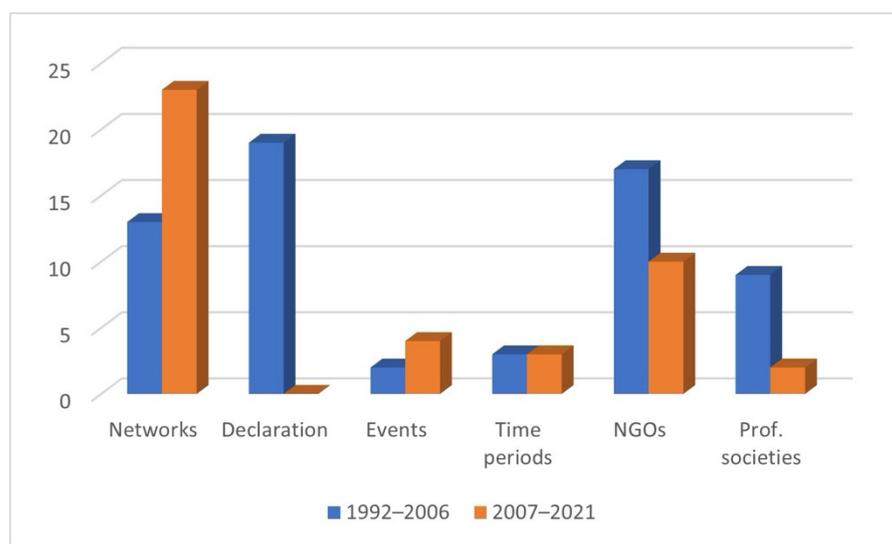


Figure 7. Comparison of GWI growth, 1992–2006 vs. 2007–2021.

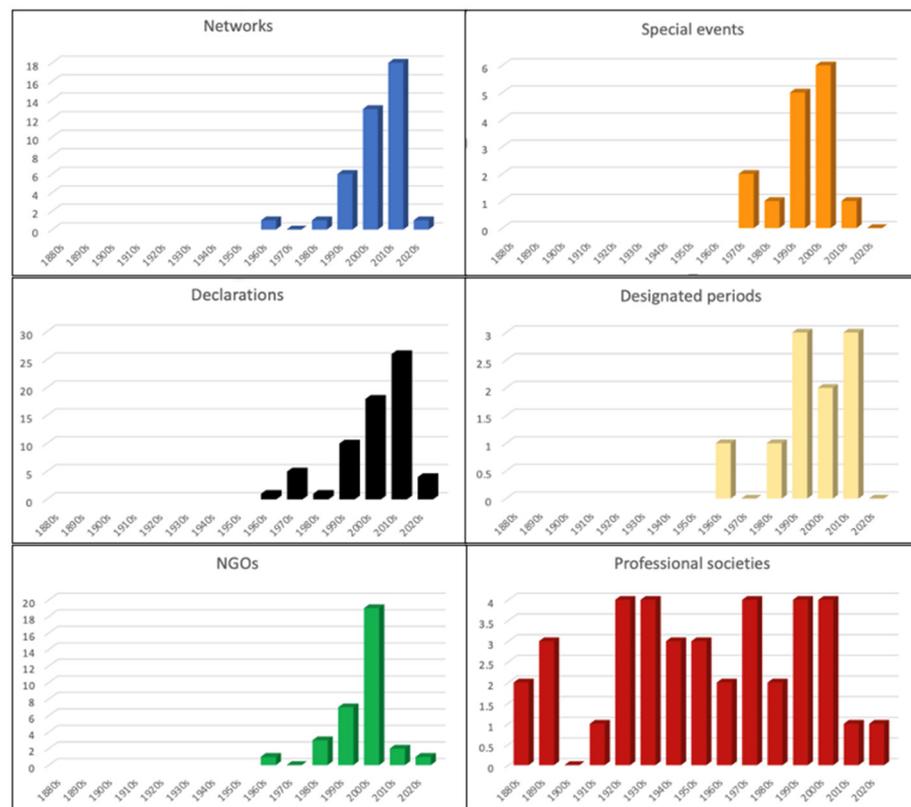


Figure 8. Growth of individual GWIs, 1880s to 2020s.

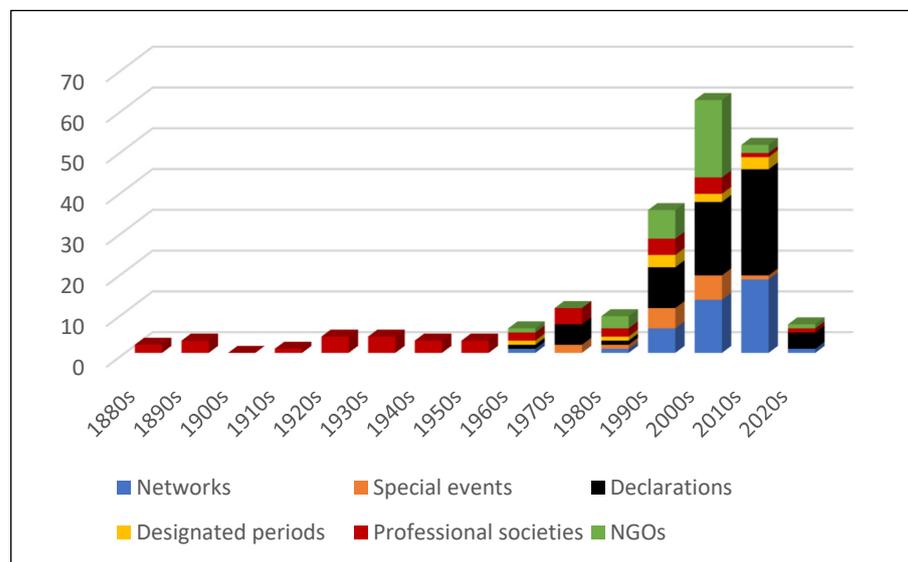


Figure 9. Overall GWI growth, by type, 1880s to 2020s.

The numbers of major global-scale, water-themed events that some have termed “megaconferences” grew substantially during the 1992–2003 period [61], a trend that subsequently stabilized (only four new ones have emerged since 2007). However, this stability masks two major characteristic of such events. First, they recur periodically—some at fixed intervals, others more ad hoc. As a result, while the number of distinct events may not have increased substantially, there are nevertheless numerous such conferences occurring each year (e.g., WWFs every three years). Additionally, second, while few new events have been added, those that have continued to exist have vastly increased their

level and diversity of participation—e.g., from a modest beginning of some 500 attendees at the inaugural 1997 WWF in Marrakech, Morocco, to numbers reputedly in the tens of thousands at seven subsequent Forums.

These attendance figures range from 20–25,000 in Mexico City in 2006 to wildly high estimates of up to 120,000 in Brasilia in 2018, and 250,000 in Kyoto in 2003. Figures for the 9 March 2022 WWF in Dakar are unavailable, but attendance was likely limited by the ongoing COVID-19 pandemic. The attendance totals, which appear in post-event press release by the host country organizers and are shown in Wikipedia, are likely highly inflated by publicists and should be viewed with skepticism. While the actual attendance totals are unreliable, it is clear that the WWFs and other large global water events have been extremely popular venues. Even critics like Lane [61] have conceded that—because they facilitate dissemination and discussion of research and information, management techniques, and specialized networks—these conferences have “made a lot of progress on establishing global aims and priorities for the water sector”. Additionally, writing on the heels of the massive 2002 World Summit on Sustainable Development (WSSD), Seyfang [62] observed that such events provide a place where “citizen’s groups can network and share ideas and experiences and return home energised and inspired to drive forward grassroots action for sustainability, with or without the leadership of their policy makers”.

Water megaconferences also have served as important points of contact for government ministers and officials, professional water managers, academics, community organizers, environmental interest groups, developers of water-related technologies, and members of the press [63]. However, they have drawn disapproval for their high cost and profligacy ([14,61,64]). Additionally, they have been taken to task for their seeming inability to result in palpable change on the ground. Ingram wrote in 2013 [65] that “Hundreds of conferences promoting model statutes, participatory planning processes, and best practices and the transfer of professional knowledge have taken place”. Ingram [65] also notes that “water problems continue unabated and even worsen”.

Nevertheless, there is evidence that such gatherings *have* influenced global discourse on governance. Following a long tradition of UN declarations on any number of global issues [66], at the closing ceremonies of water megaconferences, the organizing committees invariably issue statements, declarations, and action plans. Such plans, according to Asamoah, tend to “influence to some extent the work of several international and regional organizations”. Additionally, as Falkenmark [43] observed, water conferences foster awareness and encourage “efforts towards transferring knowledge in understandable form to policy makers and decision makers”. As a result, elements of conference declarations often find their way into national and regional policies and UN actions such as the SDGs.

Figure 9 details the progression of GWI formation by type. Both that figure and the graphs in Figure 8 indicate that the 2010s experienced a tangible slowing of proliferation—except, as already noted, for networks and declarations. Figure 9 also shows that 19 new water-related NGOs were formed during the 2000s decade—a marked difference from seven in the 1990s, two in the 2010s, and one thus far in the 2020s—indicating that the ensemble of NGOs may have achieved stasis. Finally, Figure 10 depicts the cumulative, year-by-year growth pattern for all GWIs. It confirms the accelerated growth of GWIs between 1990 and the end of the 2010s.

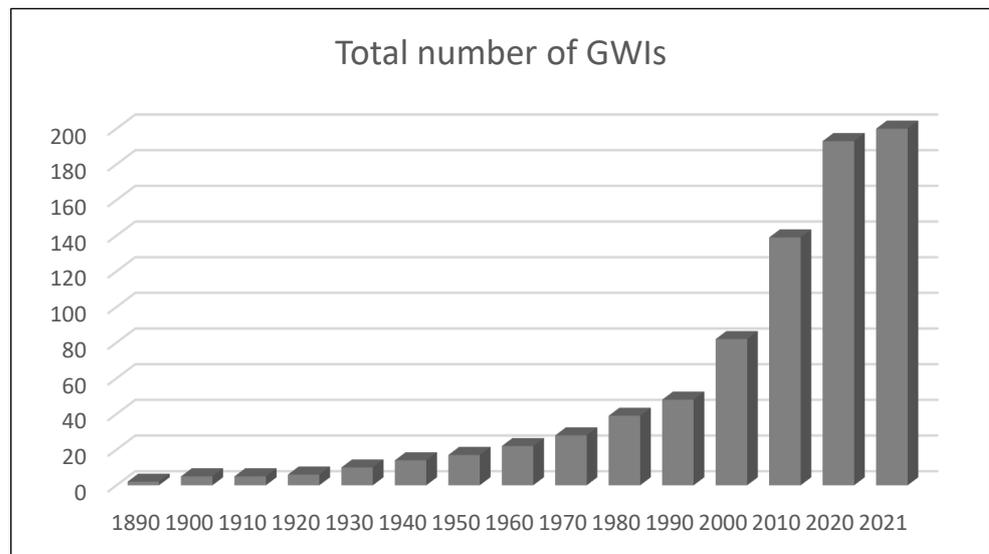


Figure 10. Cumulative growth of GWIS, 1885–2021.

The number of global water events grew at about the same rate as did time periods and NGOs (all between 40 and 50 percent over the past 15 years). It is instructive to view the geographic range of their venues. Figure 11 identifies the locations of 35 such events and it shows that more than half of them took place outside Europe—a trend that began from the start, with the triennial World Water Congresses of the International Water Resources Association and the WWFs of the World Water Council, both of which have sought to convene across the globe.

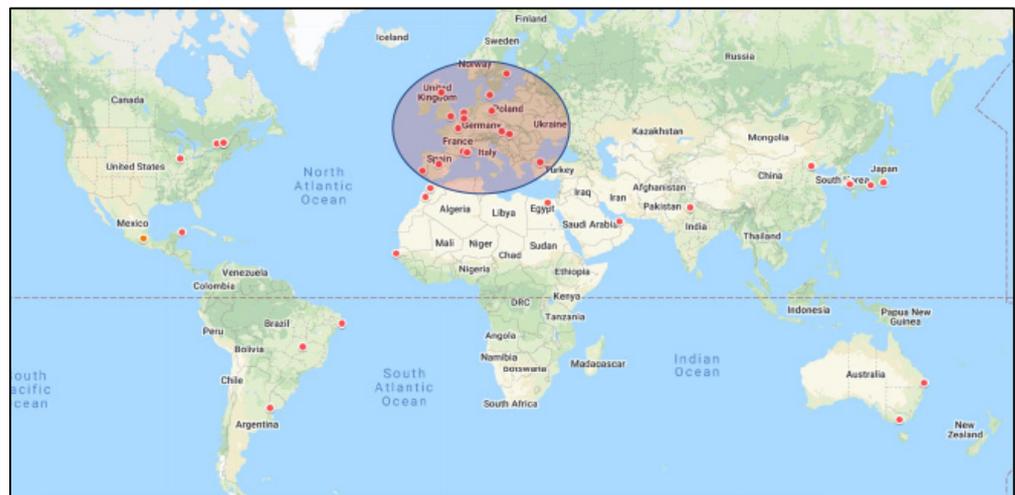


Figure 11. Sites (red circles on map) of major global water events.

A few regularly occurring conferences like the annual Stockholm Water Week events hosted by the Stockholm International Water Institute and the triennial Budapest Water Summits occur at a fixed location. However, most organizers have attempted to distribute these large events broadly, albeit with major gaps in coverage—most noticeably in Sub-Saharan Africa and Southeast Asia.

4.2.4. Using Text Analysis of International Water Declarations to Reveal Changing Concepts over Time

Water megaconferences customarily issue statements summarizing the multiday proceedings and calling for specific actions. These declarations range in length from terse,

single-page statements to small booklets. To understand how the topical focus of GWIs has evolved over time, we determined that major international water declarations—because they consist purely of text advocating explicit principles, goals, and recommendations—were well-suited to detailed content analysis. From a set of 65 such declarations (issued between 1965 and 2022), we selected a subset whose primary focus, we determined, was to exert influence on global water governance.

For each selected declaration, text segments were chosen that pertain distinctly to water resources, along with such attributes as their availability, condition, use, management, and governance. We deliberately did not include declarations that—while clearly influential (e.g., the 1972 UN Conference on the Human Environment and the 2015 UN resolutions on the 2030 Agenda for Sustainable Development)—feature a sweeping scope, focusing on broad human and environmental issues rather than specifically on water resources. Our selection process yielded 22 declarations written between 1977 and 2022 (see Table 2).

Table 2. International water declarations analyzed.

1977–2004	2012–2022
Mar del Plata (1977)	Marseille Declaration (2012)
Dublin Statement (1992)	Delft Statement (2013)
Marrakesh Declaration (1997)	Bonn Water Declaration (2013)
Paris Declaration on Water and Sust. Dev. (1998)	Lisbon Charter (2015)
Hague Declaration (2000)	Budapest Summit Declaration (2016)
Intl. Conf. on Freshwater Ministerial Declaration (2001)	Rome Declaration on the Human Right to Water (2017)
Indigenous Declaration on Water (2001)	IWRA Cancun Declaration (2017)
World Health Org. Right to Water (2003)	World Water Forum Ministerial Declaration (2018)
Kyoto Water Declaration (2003)	Brasilia Declaration of Judges on Water Justice (2018)
Bonn Charter (2004)	Budapest Appeal (2019)
	The Water and Open Government Declaration (2020)
	Dakar Declaration (2022)

Text in the declarations was coded using Dedoose software© (version 9.0.46, Socio-cultural Research Consultants, LLC, Los Angeles, CA, USA), a qualitative data-management tool for excerpting, coding, and analyzing text. Initial coding was performed based on a list of terms in the following categories: actors, governance elements, system attributes, and system pressures and impacts. (Appendix C lists the declarations, their attributes and the codes used for text analysis.) These categories were purposively designed to tease out the priorities and values described in declarations (system attributes), how those priorities might be addressed (governance elements), and by whom (actors)—as well as reasons why those priorities are important (system pressures and impacts). Coding was performed iteratively, allowing for new codes to emerge from the text. Results were analyzed by examining the presence and frequency of codes (normalized by total length of coded text in each document) for each declaration. (See Appendix C for list of declaration analyzed and text analysis coding).

To reveal changes over time, we divided the 22 declarations into two consecutive, explicitly non-overlapping temporal groupings: 1977 to 2004 (10 declarations; 14,450 total words coded) and 2012 to 2022 (12 declarations; 13,145 total words coded). Table 2 identifies the 22 declarations consulted. The gap between 2004 and 2012 permits a clear separation between the older and newer periods, thus enabling us to find differences in discourse.

We then employed the Dedoose software to perform a content analysis. We found that some terms were present only in or appeared in more declarations from the 2012–2022 period. We believe that this reflects a shift in the focus and approach to global water governance over time. For example, the use of certain terms in recent declarations (e.g., “civil society”, “vulnerable populations/communities”, “youth”) suggests an expanding scope of stakeholders involved in water governance, and a greater emphasis on climate-change challenges and impacts, as well as the need for governance strategies to address these challenges (e.g., climate adaptation and/or mitigation, climate, resilience). Similarly, another set of terms that appeared predominantly or solely in recent declarations (e.g., “integrity”,

“adaptive”, “consensus”, “dialogue”, “knowledge sharing”, “open government”, “justice”, “accountability”, “collaborative”), suggests a broadening of governance mechanisms that emphasize collaboration, knowledge sharing, and integrity—values that reflect “good governance”. (See Appendix C for additional details on the codes used for analysis).

As Figure 12 illustrates, a broader field of actors is emphasized in the set of recent declarations. For declarations between 1977 and 2004, governments are the primary actors referenced. In the latter time period (2012–2022), declarations continue to emphasize government actors, however their focus expands to include civil society, as well as vulnerable populations and communities. Other actors that were mentioned more frequently in more recent declarations include researchers, basin authorities, the private sector, women, and youth. In contrast, attention paid to international organizations and developing countries was more evident during the 1977–2004 time period, as compared to mentions in newer declarations.

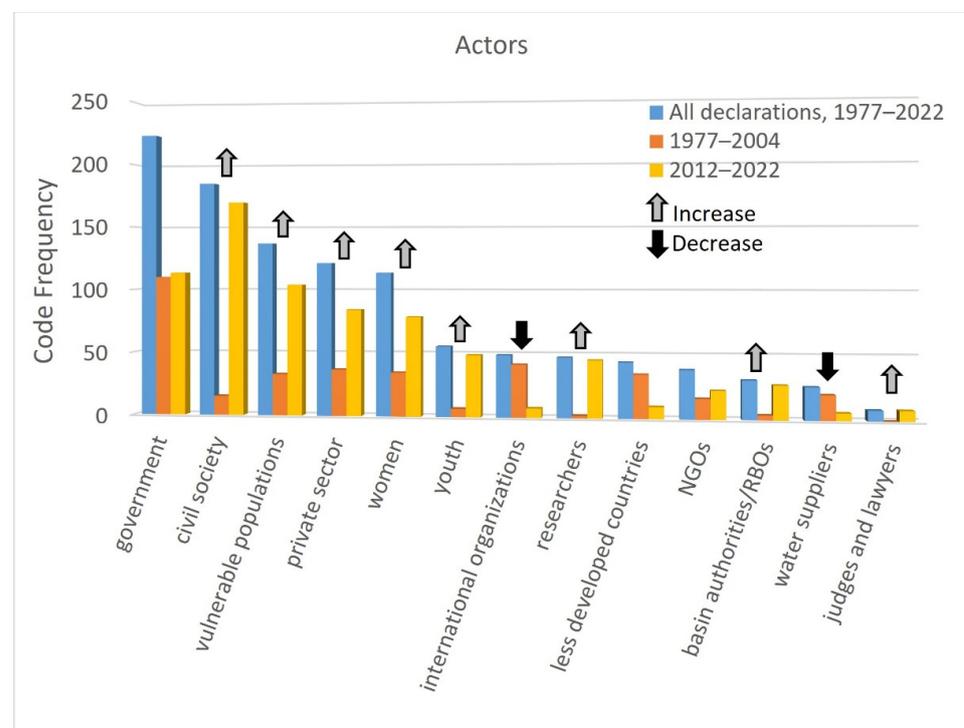


Figure 12. Code frequency for selected codes in the ‘Actor’ category. Note: Code frequency calculated per 1000 words coded, normalized by total length of text coded in each declaration, standardized to lowest whole value. Codes with increases in at least 2× and decreases in at least 0.5× between the 1977–2004 and 2012–2022 time periods are denoted by the gray and black arrows, respectively.

Figure 13 (governance-related terms) shows that throughout the full set of declarations (1977–2022), we find continuing emphasis on effective management, partnership and inclusion. In the newer declarations, we see more emphasis of the concept of “good governance”, as evidenced by a rise in the use of terms such as accountability, coordination, integration, and participation, along with greater weight to addressing change (e.g., “adaptation”, “resilience”), communication (e.g., “consensus”, “dialogue”), and transparency (e.g., “integrity”, “open government”, and “knowledge sharing”). Along with knowledge sharing, the important role of science and information is a persistent and growing focus in international water declarations. Modes of financing and the need for increased investment are also of continued interest throughout the declaration set, with emphasis growing in the recent time period.

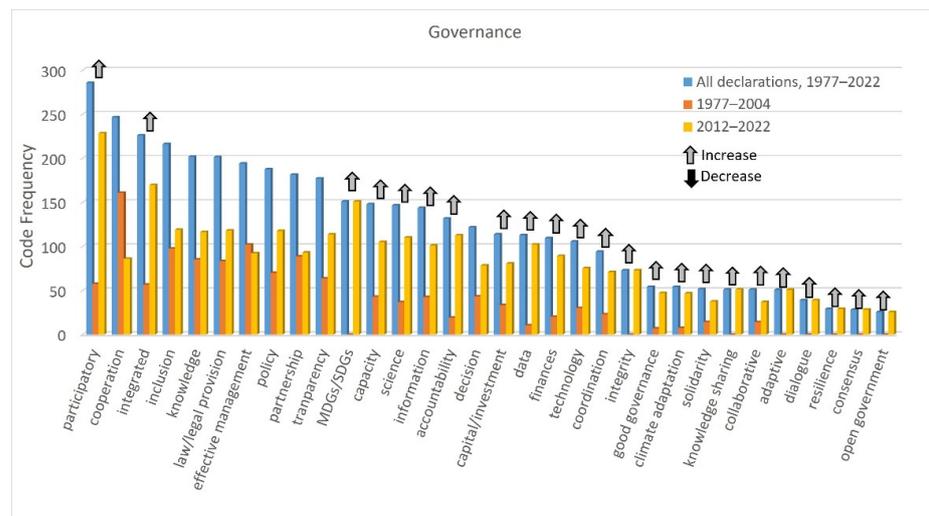


Figure 13. Code frequency for selected codes in the ‘Governance’ category. Note: Code frequency calculated per 1000 words coded, normalized by total length of text coded in each declaration, standardized to lowest whole value. Codes with increases in at least 2× and decreases in at least 0.5× between the 1977–2004 and 2012–2022 time periods are denoted by the gray and black arrows, respectively.

System attributes, as shown in Figure 14, refer to the values, priorities, or aims highlighted by international water declarations. The goals of ensuring safe drinking water, effective sanitation, water quality and sustainability are enduring and recurrent high-priority goals echoed in international water declarations from 1977 to the present day. Also consistent throughout the declarations are themes of promoting equity and equality in water-resource provision and protecting or conserving water resources. In recent years, many declarations include a new focus on justice, access, and affordability, which reflects a broadening understanding of social dimensions of water-resources management and water security.

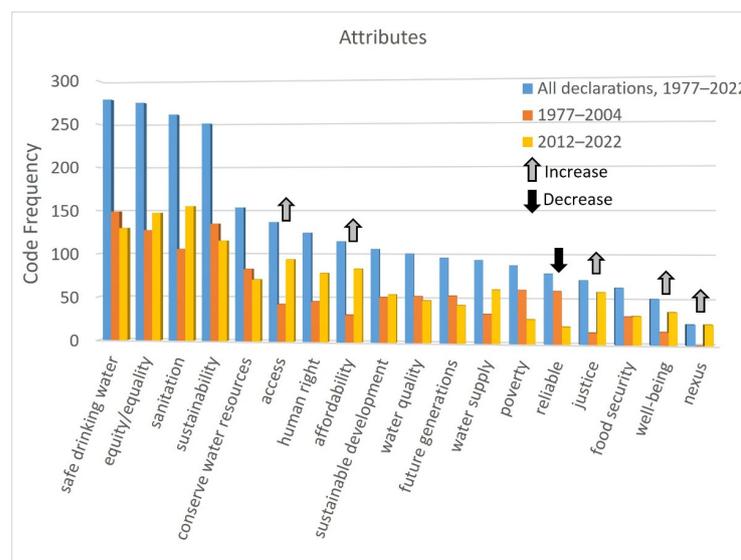


Figure 14. Code frequency for selected codes in the ‘Attribute’ category. Note: Code frequency calculated per 1000 words coded, normalized by total length of text coded in each declaration, standardized to lowest whole value. Codes with increases in at least 2× and decreases in at least 0.5× between the 1977–2004 and 2012–2022 time periods are denoted by the gray and black arrows, respectively.

While the 1977–2004 declarations highlight the pressures of water pollution and development or industrialization, Figure 15 reveals that in more recent years, declarations pay increased attention to the impacts of climate change, as well as to adaptation and mitigation strategies. Throughout the entire set of declarations, impacts to ecosystems and ecology were frequently considered, while recent declarations also feature increasing attention to biodiversity.

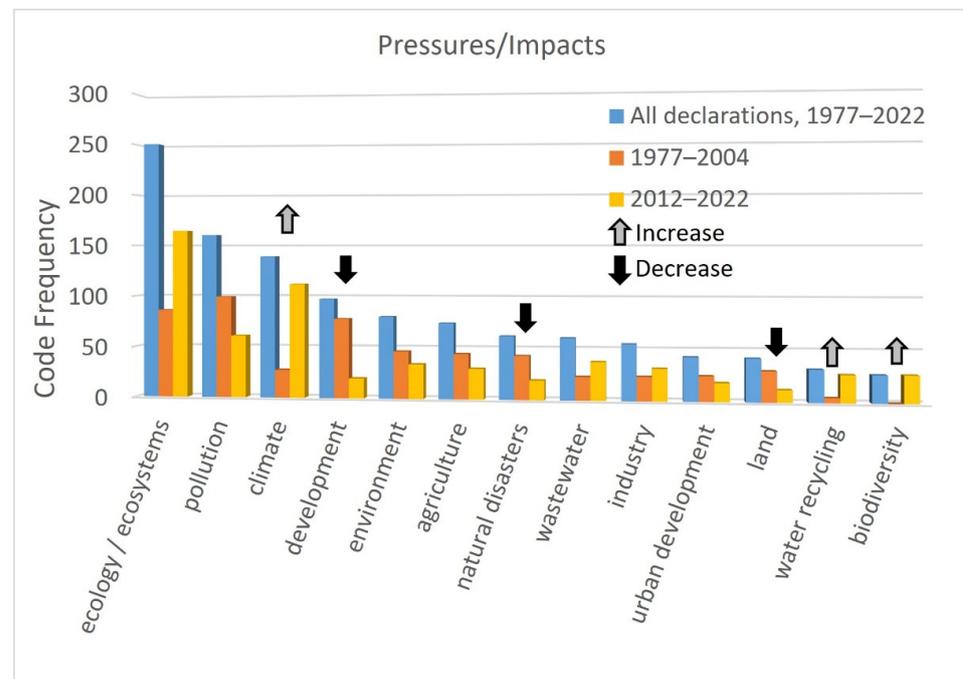


Figure 15. Code frequency for selected codes in the ‘Pressures/Impacts’ category. Note: Code frequency calculated per 1000 words coded, normalized by total length of text coded in each declaration, standardized to lowest whole value. Codes with increases in at least 2× and decreases in at least 0.5× between the 1977–2004 and 2012–2022 time periods are denoted by the gray and black arrows, respectively.

Examining the content of international water declarations can help us understand which priorities and aims have been emphasized by nations and international organizations for global water governance over time. Our analysis reveals both water governance aims that have been persistent and others that have evolved over time reflecting shifts in the role of global water initiatives in shaping water governance. International water declarations continue to aim at providing safe drinking water and sanitation through effective water management, pollution control, and investment in water services.

Challenges that dominated in global water governance decades ago—development, industrialization, and pollution—now share the stage with growing concern over climate change and associated environmental issues such as protecting biodiversity. The declarations also reveal a diversification of global water-governance actors, deepened engagement with social aspects of water-resources management such as water affordability, access and justice, and growing emphasis on inclusive, transparent, participatory, and integrated governance modes. These goals and aims signal new directions for global water initiatives to influence water governance (see Appendix A for a list of global water initiatives by type).

4.2.5. Advent and Influence of International Water Networks

Of the six categories of GWI we examined—professional societies, designated periods, special events, organizations, declarations, and networks—we find that networks are unambiguously in the forefront of GWIs that have proliferated substantially. Figure 8 reveals that this new role for networks, in addition to declarations analyzed in the previous

section. Here, we discuss the rising relevance and influence of networks. We understand networks to be groups or systems of interconnected individuals who, in association as epistemic communities Molle [21], share common interests or goals. Pahl-Wostl [23] adds that networks tend to self-organize and that the most influential ones are often informal. By contrast, engineers (e.g., Savic and Walters [67]), commonly use the term (as in “sustainable water networks”) to refer to physical linkages such as water-delivery systems.

Table 3 identifies 39 international water networks, the earliest of which was established in 1985. The table also shows that only six additional networks were created before the turn of the century. The 2000s and 2010s, by contrast ushered in 13 and 18 new networks, respectively. Writing at a time that saw the flowering of the Internet, World Bank official Wolfgang Reinicke [45] anticipated this growth trend. He noted that “governments, international organizations, advocacy groups, and private firms are joining together to radically change the way that global public policy is made and implemented”. Citing a World Bank survey that identified about 50 global networks, he stated that these mostly new associations “thrive in a borderless environment and capitalize on technological innovation” [45]. He was referring generally to what he called “global public policy networks”, but his observation perfectly fit the advent of global water networks.

Table 3. International water networks in order of date established.

International Water Networks	
Intl. Rivers Network (1985)	Smart Water Networks Forum (2010)
Earth System Governance Project (1990)	Sanitation and Water for All (2010)
Rural Water Supply Network (1992)	Alliance for Global Water Adaptation (2010)
Global Water Partnership (1996)	Waterlex (2010)
Global Energy & Water Exchanges (1998)	Intl. Water Security Network (2013)
Hydrology for the Environ., Life & Policy Initiative (1999)	Water Future (2013)
Institutional Dimensions of Global Environ. Change (1999)	World Youth Parliament for Water (2013)
Gender and Water Alliance (2000)	Geneva Water Hub (2014)
Freshwater Action Network (2000)	Water Ethics Network (2014)
Blue Planet Network (2002)	Agenda for Change (2015)
Global Water System Project (2004)	The Water Network (2015)
Global Water Challenge (2006)	Women for Water Partnership (2015)
Safe Water Network (2006)	Women 2030 (2016)
Water Integrity Network (2006)	Water Info. Network System (2017)
European Water Partnership (2006)	Community of Practice on Water & Open Govt. (2017)
Sustainable Sanitation Alliance (2007)	Global Water Security & Sanit. Partnership (2017)
Global Water Initiative (2008)	Univ. Partnership for Water Coop. & Diplomacy (2018)
The Water Footprint Network (2008)	Networking Water (2018)
Intl. Network of Water Training Centers (2008)	Bonn Water Network (2020)
Global Water Operators Partnerships Alliance (2009)	

In a similar large-picture vein and assuming—like other commentators (e.g., Conca [59]; Lemos and Agrawal [68])—that governance includes processes within and outside the formal state apparatus, in commentary titled, “Exploring Global Governance Networks”, Paterson [47] asks “how is global governance organized?” Answering his own question, he concludes that for many complicated issues, “it is being pursued at multiple sites, by different actors, at different levels and, in many cases, across space in a messy transnational fashion”. These actors engage in a mild type of transnational rule-setting [69], and according to Kramer and Pahl-Wostl [70], tend to “cooperate in producing knowledge and information [that provides] an interdisciplinary/cross-sectoral perspective”. In sum, as Mukhtarov [22] sees it, global networks “package and promote” water policies by disseminating joint knowledge and lessons learned.

This interpretation of the close link between the power and influence of networks and the relevance and effectiveness of governance conforms to our own view. In our essay, “Charting the emergence of ‘global water initiatives’ in world water governance” [10], we noted that “active affiliations through contingent and decentralized networks, rather than via formal, predetermined linkages” are at the heart of how networks influence public policy at various levels—especially at the global scale, through such actions as hydrodiplomacy [53,71]. According to Newton [72], writing about what he sees as the absence of a formal, well-defined global water-governance regime, international water networks are a

sort of proxy, serving as “communities that influence states’ and, by extension international, behavior”.

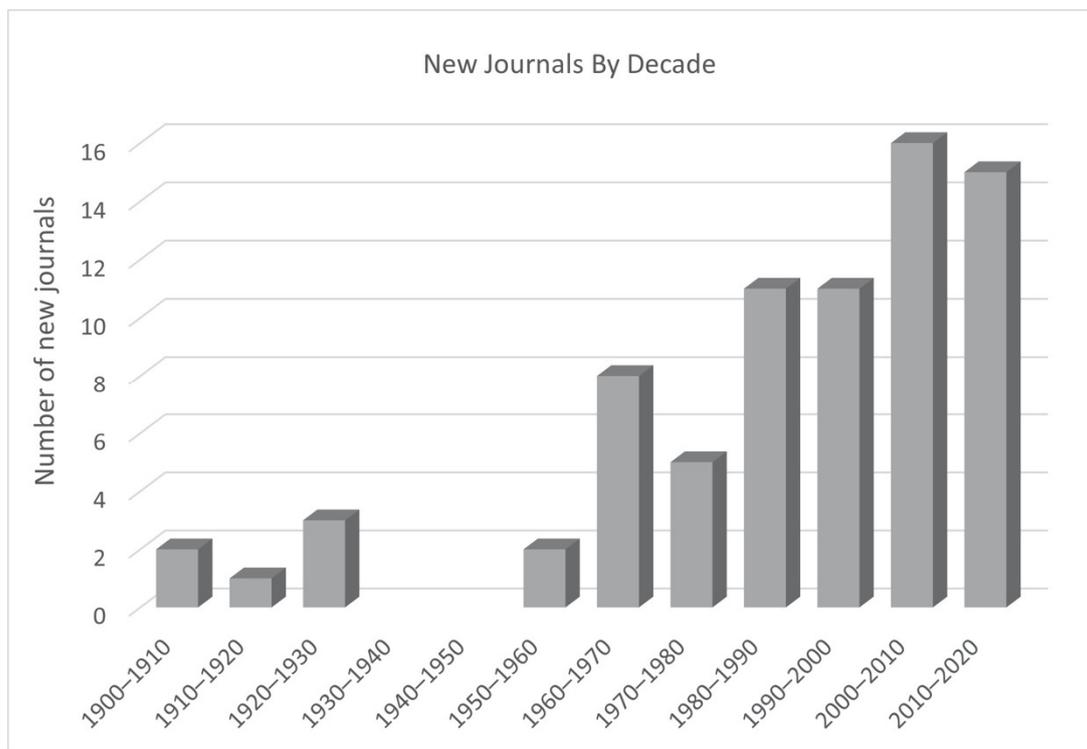
As the pace of creation of new water networks accelerates and generates ever-more specialized subnetworks—on such previously underrepresented topics as gender, ethics, communities of practice, diplomacy, and the role of academia—*networks likely will continue to be at the forefront of global water governance and policy, remaining an important type of global water initiative.*

4.2.6. The Role of Professional Journals

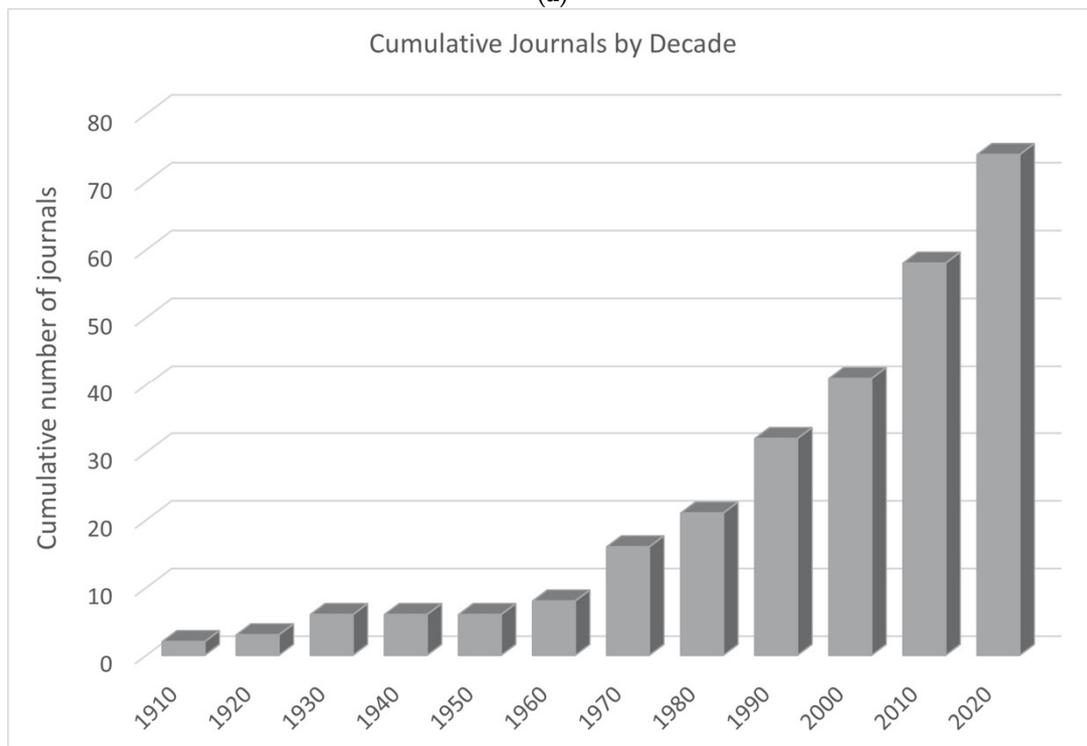
Since the mid-2000s scholars have expanded their views of how information and knowledge are transmitted to include the concept of social learning and its usual effect, the co-production of science and policy [73]. This notion stresses that information flows go both ways, not just from experts to users; it also acknowledges the important role of learning from context, as well as from published knowledge [74,75]. While this revised view of knowledge transfer enriches our epistemological understanding, we recognize that published scientific literature continues to occupy an important niche. Dissemination of research through journal publications is a key mechanism for (1) transferring knowledge from basic and applied sciences to decisionmakers and stakeholders, (2) sharing research finding among countries and regions that face similar challenges, and (3) advancing collective action on global water issues [76]. Published research strongly influences technological innovation, decision-making, and on-the-ground implementation. For this reason, we consider the suite of water-themed journals as *an outgrowth of the activities of global water initiatives whose outputs are helpful in understanding the overall impact of GWIs.*

To evaluate the role of professional journals within the broader GWI landscape, we compiled a list of water-focused academic journals. We searched journals indexed in the Web of Science database using topic searches for “Water” and “Water Resources” and conducted additional snowball sampling while researching the resulting records. We retained those journals with a primary focus on water-related topics and a global (versus regional) scope. Journals with a broad purview that include water-related topics while also featuring other topics were not considered. Engineering-focused journals (e.g., topics such as hydraulic engineering) and irrigation-specific journals also were excluded. For the remaining journals, we obtained the year of establishment and other information, such as aims and scope. Grey literature, such as agency or NGO reports, non-refereed journals, and media such as magazines and news articles were not included. Similar bibliometric approaches have been used to understand the contribution of an individual journal to the field of water-resources research [77] and to evaluate the evolution of subfields within water research [78].

Our search generated 74 water-focused academic journals that were established between 1902 and 2022. The number of newly established water-focused journals increased in the 1960s and remained high from the 1980s until today. The cumulative number of such journals has steadily increased since 1960 (see Figure 16a,b and Table 4).



(a)



(b)

Figure 16. (a) New water-focused journals by decade. (b) Cumulative number of water-focused journals over time.

Table 4. Top 20 water-focused journals by record count based on Web of Science results for the “Water Resources” category (accessed June 2022).

Journal Titles
<i>Water Science and Technology</i>
<i>Water Research</i>
<i>Journal of Hydrology</i>
<i>Water Resources Research</i>
<i>Desalination and Water Treatment</i>
<i>Water</i>
<i>Desalination</i>
<i>Water Air and Soil Pollution</i>
<i>Hydrological Processes</i>
<i>Agricultural Water Management</i>
<i>Journal American Water Works Association</i>
<i>Hydrology and Earth System Sciences</i>
<i>Water Resources Management</i>
<i>Advances in Water Resources</i>
<i>Journal of Soil and Water Conservation</i>
<i>Water Environment Research</i>
<i>Hydrological Sciences Journal</i>
<i>Groundwater</i>
<i>Journal of Contaminant Hydrology</i>
<i>Hydrogeology Journal</i>

Water-focused journals cover a range of academic disciplines, including physical sciences, applied sciences and technology, social sciences, and policy and management (see Table 5). Topics of focus extend across hydrogeology, ecohydrology, desalination and water reuse, contaminant hydrology, water and climate change, water governance and policy, and international water issues. A rising number of water journals with narrow topical focus (e.g., *Desalination*, *Vadose Zone Hydrology*, *Mine Water and the Environment*) demonstrates the growth of the field through the ability to maintain publications and readership for such specific areas of expertise.

Table 5. Examples of journals associated with professional societies.

Journal Title	Year	Professional Society
<i>Journal American Water Works Assoc.</i>	1914	American Water Works Assoc.
<i>Water Environment Research</i>	1928	Water Environment Federation
<i>Hydrological Sciences Journal</i>	1953	Intl. Association of Hydrological Sciences
<i>Groundwater</i>	1963	National Groundwater Assoc.
<i>Water Resources Research</i>	1965	American Geophysical Union
<i>Journal of the American Water Resources Assoc.</i>	1965	American Water Resources Assoc.
<i>Water Research</i>	1967	Intl. Water Assoc.
<i>Journal of Soil and Water Conservation</i>	1967	Soil and Water Conservation Society
<i>Water International</i>	1972	Intl. Water Resources Assoc.
<i>Water Science and Technology</i>	1982	Intl. Assoc. on Water Pollution Research
<i>Water Resources Management</i>	1987	European Water Resources Assoc.
<i>Hydrogeology Journal</i>	1992	Intl. Assoc. of Hydrogeologists
<i>Hydrology and Earth System Sciences</i>	1997	European Geosciences Union
<i>Water History</i>	2009	Intl. Water History Assoc.

Academic journals often exhibit links to GWIs. For example, special issues of journals on contemporary topics may be associated with special events and designated time periods. Conferences and events provide venues to organize communities of practice or research collaborations that may result in “special topic issues” in publications [76]. Moreover, more than half of the water-focused journals are associated with professional societies (see Table 5). Additionally, as the field of water resources grows and evolves, international associations and organizations can help expand research on timely issues, particularly global comparative studies [79]. Those associations may sponsor academic publications to

engage with their members, promote knowledge-sharing, and build a readership around key research topics. While the rise in numbers of journals and articles is palpable, some ask whether this increase reflects academic publish-or-perish pressures, leading to proliferation of papers of only marginal academic or practical value [76].

One of the earliest water-specific journals—first published in 1914—the *Journal of the American Water Works Association (Journal AWWA)*—is the flagship publication of the AWWA (itself established in 1881). The publication serves as a reliable source of information regarding industry developments for researchers and industry professionals and as a forum to discuss innovations and challenges in the field. As another example, *Hydrological Sciences Journal* is the official journal of the International Association of Hydrological Sciences (IAHS), which was organized in 1922; *Hydrological Sciences Journal* covers all aspects of hydrology, including the management of water resource systems. Additionally, IAHS convenes conferences, organizes working groups, designates time periods, publishes proceedings and reports, and in 1953 founded its flagship journal as a forum to exchange ideas, information, and scientific results on hydrology among its global membership and broader readership.

The International Water Association, established in 1999–2000, is a leading exemplar of the link between professional societies and journal activity. The association sponsors 15 publications, many of which are issued in house by IWA Publishing. Examples include *Hydrology Research*, *Water and Climate Change*, *Water Reuse*, *Water Supply*, and *Water Policy*. IWA also publishes *Water Research*, and *Water Research X*—an open access version of the former—in association with Elsevier. Publishing is just one facet of IWA’s operations, which also include global networking, professional and industry leadership, and agenda-setting for the water industry.

Overall, water-focused journals—either in connection or not with professional societies—serve to link researchers, policymakers, and practitioners; share and distribute field-specific knowledge; and advance developments in the field (see Table 6). *We believe the growing number of water-focused journals provides additional evidence for the rising collective influence of GWIs. Nevertheless, the persistence of numerous water challenges suggests that expanding water research and dissemination alone remains insufficient for achieving practical solutions, especially at the global scale.* Water research must continue to become more inclusive and accessible, maintain high standards, and thoughtfully connect research endeavors to produce information that is seen as both valuable and usable by policymakers [76]. Additionally, going even further, in the words of Falkenmark [43], “In order to mitigate the looming world water crisis, water has to be made everybody’s business”.

Table 6. Examples of selected UN agencies and their water-related interests.

Member Organizations	Main Water-Related Interests
FAO (Food and Agriculture Organization of the United Nations)	Food security, irrigation, drought, early warning systems, water use efficiency
UNDP (UN Development Programme)	Rural development, climate resilience & poverty eradication, sustainable water governance
UNECE (UN Economic Commission for Europe)	Environ. monitoring, transboundary watercourses, transboundary effects of industrial accidents
UNEP (UN Environment Programme)	Environ. aspects of sustainable development; custodian of three SDG 6 indicators on water quality, IWRM & freshwater ecosystems
UNESCO (UN Educational and Scientific Organization)	Water research, education & capacity building; water-resources management & governance
UN Framework Convention on Climate Change	Climate change, drought, risk, adaptation
UN-Habitat (UN Human Settlements Programme)	Safe, resilient & sustainable cities and communities
UNICEF (UN Children’s Fund)	WASH in schools & health centers, with particular attention to gender considerations & specific needs of women, girls & children living with disabilities
UN Office for Disaster Risk Reduction (UNDRR)	Climate change, ecosystem fragility, unplanned urbanization, political & financial instability
UN Women (UN Entity for Gender Equality & the Empowerment of Women)	Access to health care, gender wage gaps, employment opportunities
The World Bank	Financing for water infrastructure & management in developing countries
World Health Organization (WHO)	Water quality, water-borne disease, climate change and health, sanitation, WASH
World Meteorological Organization (WMO)	Climate, meteorology, precipitation; hydrology in sustainable devel.; risk reduction & impacts of water-related disasters; environ. management at intl., regional, national, basin levels

4.2.7. The UN's Mounting Involvement: UN-Water, the Millennium Development Goals (MDGs), and Sustainable Development Goals (SDGs)

The role of UN institutions in global water governance has been significant and steadfast over time [17]. Numerous UN institutions include aspects of water-resources issues in their scope of work and thus have contributed to the GWI landscape through a variety of venues, including organizations, networks, events, and declarations (see Table 6 and Appendix B).

In 1975 the UN established the International Hydrological Programme (IHP), an IGO governed by Member States and an Intergovernmental Council [8]. There are currently 195 "Member States" and 36 "Members" of the Intergovernmental Panel. Initially managed jointly by UNESCO and WMO, IHP always has been hosted by UNESCO, which has administered and funded IHP. Thanks to this integral connection to IHP, UNESCO—whose mission centrally includes science—took on a leading role within the UN family in promoting and enabling the pursuit of water science [80]. Via a series of strategic multiyear plans—IHP I (1975–1980) through the current IHP IX (2022–2029)—IHP has actively pursued a comprehensive assortment of water-related goals. Adding to its constant emphasis on hydrological sciences research, UNESCO expanded its purview to such topics as education (another of the organization's pillars), capacity building, management, sustainability, climate, and—via its PCCP ("From Potential Conflict to Cooperation Potential") initiative [81]—conflict and cooperation. In tandem with UNESCO's own agenda, each IHP plan has been oriented to a specific theme (e.g., IHP-VIII was titled "Water Security" and IHP-IX, "Science for a Water Secure World in a Changing Environment" [82]. Until the creation and growing role of UN-Water, UNESCO was commonly viewed as the principal face of the UN on water-related matters.

UN events, conferences, and declarations have played an important role in awareness raising around global water issues, principles, and goals. The 1977 UN Water Conference at Mar del Plata served as a turning point that initiated discourse on water governance on the global stage [29]. Since that time, UN initiatives have continued to promote principles of global water governance. A set of four water-governance ideals, the Dublin Principles was the outcome of the UN's 1992 International Conference on Water and Environment. The Dublin Principles have guided approaches to water governance and their publication prompted the formation of new initiatives and organizations to implement them [29,72]. More recently, in 2010 the UN General Assembly adopted and has continued to advocate for UNGA Resolution 64/292, "the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights".

Other UN GWIs highlight knowledge generation and dissemination. An example is the World Water Assessment Program (WWAP), established by UNESCO in 2000. WWAP is an ongoing effort that produces annual World Water Development Reports on thematic aspects of the world's freshwater resources. Similarly, a joint effort of WHO and UNICEF—the Joint Monitoring Programme for Water Supply and Sanitation—was established at the end of the International Drinking Water Supply and Sanitation Decade (1981–1990).

Notwithstanding these and similar contributions, the leadership of UN organizations on global water issues since Mar del Plata has often been considered fragmented and uncoordinated [83]. In spite of UNESCO's persistent efforts—principally via IHP—to serve as a focal point for water-related efforts, actual coordination among UN organization remained fragmented at best and competitive at worst. As Newton [72] has observed, UN agencies and other organizations were attempting to fill a void, but in a piecemeal manner, "each in its place in a great complicated amoeba".

To address the diffuse nature of the UN's water-related activities, in 2003 water-resources efforts were consolidated under UN-Water as a new umbrella mechanism [84]. UN-Water has 33 "Member" UN organizations, 5 "Partners with Special Status", and 38 "Partners". (See Appendix B for a list of UN-Water Organizations.) The coalescence of the UN's far-reaching water activities under the UN-Water umbrella has been seen by some as a significant development [29]. UN-Water was tasked with coordination on technical issues

and was designed in part to help implement the Millennium Development Goals and water-related actions identified by the 2002 World Summit on Sustainable Development [26].

UN-Water's formulation also marked a shift toward more inclusive water governance involving a variety of stakeholders in addition to UN Member States [26]. UN-Water contributes via three primary pathways: informing policy, generating knowledge, and raising awareness. Conferences and declarations promote principles and overarching goals, while advocating specific actions in the global arena. Knowledge is produced via regular assessments conducted in coordination with multiple UN agencies, such as WHO, UNESCO, and UNICEF. UN-Water enhances awareness and encourages action through international events and observances, such as World Water Day, World Toilet Day, and the Water Action Decade [85]. (See Appendix B for list of UN-Water organizations).

The UN's MDGs comprised the first international agenda that aimed to comprehensively address global challenges through ambitious, long-term goals paired with measurable targets [86]. They were focused primarily on global development challenges, and water was included only under the large umbrella of Goal 7—"Ensure Environmental Sustainability"—with the aim to "half the number of people without access to safe drinking water and basic sanitation by 2015". While water was acknowledged in the MDGs, its incorporation was heavily weighted toward WASH-related issues and lacked a more holistic scope of water-related issues [86]. For those who held a more water-centric view of development, the MDGs did not go far enough; they believed that water underpinned all eight goals and that MDG targets were unachievable unless specific water targets were accomplished [72].

At the Rio+20 summit in 2012, an invigorated UN-Water—a GWI comprising an extensive network of agencies, organizations, individuals, events, conferences, publications, and declarations—participated as a technical advisor and convener of international water actors. Along with other institutions—including several influential conferences such as the 2013 Budapest Water Summit—UN-Water began advocating for a distinct, dedicated, stand-alone water-specific goal as part of the incipient Sustainable Development Goals (SDGs). With UN-Water spearheading the multiple UN agencies, the call succeeded and yielded SDG 6, whose brief was to "Ensure availability and sustainable management of water and sanitation for all" [86,87]. In the years since, with SDG 6 firmly in place, determining appropriate and specific indicators to evaluate its water resource-related targets remains a thorny and often elusive challenge [29].

After an uneven start, UN-Water has received better grades for coordination on events, reports and policy briefs. More generally, the unit has enhanced how UN agencies and partners work together, successfully managing to "join different silos within the international water community for the first time, as all actors worked on a common agenda" [86,88]. Some believe that this mechanism will help bridge gaps between knowledge generation and policy formulation at the global level [29,89]. Still, UN-Water struggles with the task of coordinating among many agencies and interest groups [29] and the number of initiatives continues to diffuse the mechanism's impact [72]. This is partly attributable to UN-Water's lack of a strong mandate and policy-making ability [18]. Additionally, competition among UN agencies persists even under the UN-Water umbrella, and global water governance remains fragmented among many actors and agencies [26].

Nonetheless, the sheer number of UN agencies and partner organizations that contribute to UN-Water and the reach of the organization ensure that it will remain an influential global water initiative. UN-Water plays a meaningful linking role in global water governance—similar to that of other multistakeholder platforms [26]. As such, it helps connect knowledge generation with politics, while exerting a tangible if still limited impact on policymaking [26].

5. Conclusions

The noted water scholar James Westcoat reminds us that "as new water organizations make history, they will also be well-advised to draw upon the rich body of historical

research on water problems [79]". In this paper, we have attempted to distill the history, expansiveness, and interconnectedness of global water initiatives. In this way, we have hoped to illuminate the complex and overlapping roles these entities continue to play in shaping global water discourse and moving toward solutions for solving ongoing and emerging water issues.

In this "redux", we have revisited and undertaken a scholarly review of prominent water-governance literature and anchored it within the historical context of GWIs. Compilation of existing and new GWIs allowed us to discern trends in individual and collective GWI growth patterns—most notably that "professional societies", the oldest and most formative GWIs, remain resilient and ever-evolving, while "networks" and "declarations" are now the fastest-multiplying type of global water initiative. Text analysis, followed by content analysis of international water declarations, revealed the changing foci, vocabulary, and priorities expressed in declaration. Bibliometric evaluation helped us ascertain the role and specializations of water-themed professional journals within the broader GWI landscape. Our extensive collection of figures, tables, and appendices captured the evolving nature of GWIs and visually show that GWIs are not representative of a perfect tessellation and are in fact present with gaps and significant overlap that should be further studied.

To recapitulate our key findings, we have determined that: (1) GWIs have diversified, expanded their constituencies, and gradually extended their influence over how water is perceived, governed, and managed; (2) the institutional landscape within which GWIs exist and operate is continuously shifting to accommodate and lubricate the spread of new ideas, ways of thinking, and available science and tools; (3) networks, megaconferences and their declarations, and water-themed journals likely will continue to be at the leading edge of global water governance and policy; and (4) the advent of the Millennium Development Goals and Sustainable Development Goals has enhanced the relevance of UN-Water, the network of water-related UN agencies.

The past two decades have seen a palpable diversification of global water-governance actors, accompanied by a deepened engagement with social justice, access and affordability, and water-food-energy nexus aspects of water-resources management. Special global water events have been instrumental in convening attendees drawn from multiple sectors and diverse locations, representing different backgrounds, and bringing a diverse assortment of ideas about how water should be managed and governed. All this signals a panoply of new opportunities for GWIs to influence water governance.

Our research confirms that the number of professional societies, special events, designated time periods, and organizations grew throughout the 20th century, and in some cases accelerated over the last two decades. Since our previous work, we have seen an expansion of GWI activity, including the significant rise in prominence of three aspects of this activity: networks, declarations and statements, and water-themed publications. GWIs have also increasingly diversified in composition and their collaborative assets have become available to broader audiences, including diplomats, policymakers, practitioners, community organizers, water users, academics, and others with water-related interests.

Analysis of GWI behaviors presented above found that elements of conference declarations often find their way into national and regional policies and UN actions such as the SDGs and emphasize effective governance, management, partnership, and inclusion. GWIs have helped expand the scope of stakeholders who have become involved in water governance. They also have reinforced the urgency of critical challenges such as climate change and emphasized governance-oriented strategies to address those challenges.

As an ensemble, GWIs operate within a distinct and ever-changing institutional universe. We have shown that they offer paradigms that have yielded more decentralized and integrated approaches to water management, along with new ways of thinking about sustainability, public participation, transparency, and development practices. Under the right circumstances, they have even stimulated large-scale investments in infrastructure and governance.

As we enter an era of increased globalization of water issues, inquiry, expertise, and action [79,90], we may expect GWIs to continue disseminating promising new ideas and potential real-world solutions. The extent of projected water-related problems ahead—especially looming climate-change-induced ones—underlines the need for greater attention to and more robust scholarship on the role and potential of global institutions.

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Appendix A. List of GWIs by Type

International water networks (some networks also identify as partnerships, exchanges, alliance or hubs).

- Universities Council on Water Resources (UCOWR) (1964)
- International Rivers Network (1985)
- Earth System Governance Project (orig. Intl. Human Dimensions Program on Global Environmental Change [IHDP] (1990); renamed (2014)
- Rural Water Supply Network (orig., Handpump Technology Network (1992); renamed (2004)
- Global Water Partnership (1996)
- International Capacity Development Network for Sustainable Water Management (CA (1996)
- Global Energy and Water Exchanges (GEWEX) (1998)
- Hydrology for the Environment, Life and Policy (HELP) Initiative (at UNESCO) (1999)
- Institutional Dimensions of Global Environmental Change (IDGEC) (1999)
- Gender and Water Alliance (2000)
- Freshwater Action Network (2000)
- Blue Planet Network (2002)
- Global Water System Project (GWSP) (2004)
- Global Water Challenge (2006)
- Safe Water Network (2006)

Water Integrity Network (2006)
 European Water Partnership (2006)
 Sustainable Sanitation Alliance (2007)
 Global Water Initiative (2008)
 The Water Footprint Network (2008)
 International Network of Water Training Centers (2008)
 Global Water Operators Partnerships Alliance (GWOPA) (2009)
 Smart Water Networks Forum (SWAN) (2010)
 Sanitation and Water for All (2010)
 Alliance for Global Water Adaptation (2010)
 Waterlex (2010)
 International Water Security Network (2013)
 Water Future (2013)
 World Youth Parliament for Water (2013)
 Geneva Water Hub (2014)
 Water Ethics Network (2014)
 Agenda for Change (2015)
 The Water Network (2015)
 Women for Water Partnership (2015)
 Women 2030 (2016)
 Water Information Network System (WINS) (2017)
 Community of Practice on Water and Open Government (2017)
 Global Water Security & Sanitation Partnership (GWSSP) (2017)
 Universities Partnership for Water Cooperation and Diplomacy (UPWCD) (2018)
 Networking Water (2018)
 Bonn Water Network (2020)

Declarations, statements and resolutions

European Water Charter (1965)
 General Assembly resolution 2669 on progressive development and codification of the rules of international law relating to international watercourses (1970)
 Declaration of the United Nations Conference on the Human Environment (1972)
 Resolution 3129 on Cooperation in the Field of the Environment Concerning Natural Resources Shared by Two or More States (1973)
 Mar del Plata Action Plan (1977)
 Resolution 34/186 on Co-operation in the field of the Environment concerning Natural Resources Shared by Two or More States (1979)
 Bucharest Declaration (on protecting the Danube) (1985)
 Dublin Statement on Water and Sustainable Development (1992)
 Universal Declaration of Water Rights—INDAQUA (1992)
 International Law Commission, Resolution on Confined Transboundary Groundwater (1994)
 Barcelona Declaration (1995)
 * IRIN Association (originally Integrated Regional Info. Networks) (1996) MOVED from Prof. Soc.
 Almaty Declaration (1997)
 Helsinki Declaration: Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1997)
 Declaration of Marrakech (1997)
 Paris Declaration on Water and Sustainable Development (1998)
 Strasbourg Declaration (1998)
 United Nations Millennium Declaration (2000)
 Ministerial Declaration of The Hague on Water Security in the 21st Century (2000)
 Intl. Conference on Freshwater: Ministerial Declaration (2001)
 Indigenous Declaration on Water (2001)

- Montreal Declaration of the International Commission on Irrigation and Drainage (2002)
- Right to Water, World Health Org. (2003)
- Kyoto Water Declaration (2003)
- World Medical Association Statement on Water and Health (2004); revised (2014 and 2017)
- IWA Bonn Charter for Safe Drinking Water (2004)
- Brisbane Declaration on Environmental Flows (2007)
- Message from Beppu (2007)
- Madrid Action Plan (2007)
- Lima Declaration for IWRM (2008)
- Delhi Declaration (2008)
- U.N. General Assembly Resolution on the Law of Transboundary Aquifers (2008)
- Outcome of the International Experts' Meeting on the Right to Water (2009)
- Melbourne Declaration (2009)
- Istanbul Declaration of Heads of States on Water (2009)
- UN Resolution 64/292 on the Human Right to Water and Sanitation (2010)
- U.N. Human Rights Council Resolution on Human Rights and Access to Safe Drinking Water and Sanitation (2010)
- 2011 U.N. General Assembly Resolution on the Law of Transboundary Aquifers (2011)
- Marseille declaration (2012)
- Report of the Sixth Committee, The law of transboundary aquifers (2013)
- The Bonn Declaration on Global Water Security (2013)
- Delft Statement on Water Integrity (2013)
- Budapest Summit Declaration (2013)
- UN Resolution 70/169 on the Human Rights to Safe Drinking Water and Sanitation (2015)
- Bonn Declaration on Global Water Security (2015)
- Encyclical Letter of Pope Francis 'On Care for Our Common Home' (2015)
- Daegu and Gyeongbuk Water Declaration (2015)
- United Nations Resolution 'Transforming our World: The 2030 Agenda for Sustainable Development' (2015)
- OECD Principles on Water Governance (2015)
- Brussels declaration of the European Water Movement (2015)
- Lisbon Charter Guiding the Public Policy and Regulation of Drinking Water Supply, Sanitation and Wastewater Management Services (2015)
- Resolution adopted by the General Assembly on 13 December 2016: The Law of Transboundary Aquifers (2016)
- Budapest Summit Declaration (2016)
- Bali Declaration (2016)
- Rome Declaration on the Human Right to Water (2017)
- Rome Statement on Water Scarcity in Agriculture (2017)
- Cancun Declaration (2017)
- The Dushanbe Declaration, "Promoting Action and Policy Dialogue" (2018)
- Ministerial Declaration: An Urgent Call for Decisive Action on Water (2018)
- Budapest Summit Declaration (2019)
- Cairo declaration (2019)
- Brasília Declaration on Water Justice (2020)
- Water and Open Government Declaration (2020)
- UN-Water Joint Statement: 31st Special Session of the General Assembly in response to the COVID-19 pandemic (2020)
- Dakar Declaration (2022)
- Global events** (see also declarations, which emanate from events)
- IWRA World Water Congress (quasi-triennial, since 1973)

UN Conference on Water, Mar del Plata (1977)
World Lake Conference (since 1984)
SIWI World Water Week, Stockholm (annual since 1991)
International Conference on Water and Environment, Dublin (1992)
International Congress on Irrigation and Drainage (triennial since 1993)
World Water Forum (triennial since 1997)
International Conference on Water and Sustainable Development, Paris (1998)
IWA World Water Congress (ad hoc since 2000)
International Conference on Freshwater, Bonn (2001)
Budapest Water Summit (triennial since 2013)
Conference on Water in the Anthropocene, Bonn (2013)
Cairo Water Week (annual since 2018)
Global Water Summit (annual since 2019)

Professional Societies

American Water Works Association (1881)
International Navigation Association (1885)
International Commission of Glaciers (1894)
Chartered Institution of Water and Environmental Management (1895)
Chartered Institution of Wastes Management (1898)
International Union of Geodesy and Geophysics (IUGG) (1919)
International Assoc. of Hydrological Sciences (IAHS) (1922)
International Assoc. of Theoretical and Applied Limnology (1922)
Water Environment Federation (1991); prev. called Fed. of Sewage Works Associations (1928), Fed. of Sewage & Industrial Wastes Associations (1950); Water Pollution Control Fed. (1960)
International Commission on Large Dams (1928)
International Council for Science (1931)
International Association for Hydraulic Research (1935)
Association for the Sciences of Limnology and Oceanography (1936)
International Glaciological Society (1936)
International Water Association (1999–2000); merger of Intl. Water Supply Association (1947), and International Assoc. on Water Quality, originally Intl. Assoc. for Water Pollution Research in 1965
National Ground Water Association (1948)
Irrigation Association (1949)
International Commission on Irrigation and Drainage (1950)
International Association of Hydrogeologists (1956)
International Bottled Water Association (1958)
American Water Resources Association (1964)
International Association on Water Pollution Research (1965)
International Water Resources Association (1973)
International Desalination Association (1973)
International Association of Institutes of Navigation (1975)
International Mine Water Association (1979)
Society of Wetland Scientists (1980)
International Society for Environmental Protection (1987)
International Association for Environmental Hydrology (1991)
Produced Water Society (1993)
International Hydropower Association (1995)
Constructed Wetland Association (1999)
International Water History Association (2001)
Association of Hydro-Meteorological Industry (2001)
International Society of Paddy and Water Environment Engineering (2002)
International Federation of Private Water Operators (2005)

International Lake Environment Committee (2011)
 Association of Water Technologies (2020)

Designated Time Periods

International Hydrological Decade (1965–1974)
 International Drinking Water Supply and Sanitation Decade (1981–1990)
 World Water Week (1991)
 World Water Day (1993)
 International Year of Sanitation (1998)
 International Year of Freshwater (2003)
 International Decade for Action, “Water for Life” (2005–2015)
 International Year of Water Cooperation (2013)
 World Toilet Day (2013)
 International Decade for Action “Water for Sustainable Development” (2018–2028)

NGOs

Life Water (1968)
 WaterAid (1981)
 Global Water (1982)
 International Rivers (1985)
 Living Water International (1990)
 International Secretariat for Water (1991)
 Water Step (1995)
 Water Mission (1998)
 Building Partners for Development Water and Sanitation (1998)
 GlobalAid Network (1998)
 Pure Water for the World (1999)
 Circle of Blue (2000)
 World Toilet Organization (2001)
 Center for Affordable Water Sanitation and Technology (2001)
 Global Water Trust (2003)
 Water for Good (2004)
 Food and Water Watch (2005)
 Water Environment Federation Water Advocates (2005)
 Water and Sanitation for the Urban Poor (2005)
 Charity: Water (2006)
 Global Water Alliance (2006)
 Global Water Foundation (2006)
 End Water Poverty (2007)
 Splash (2007)
 Water Witness International (2008)
 Global Women’s Water Initiative (2008)
 Planet Water Foundation (2009)
 Waves For Water (2009)
 Alliance for Water Stewardship (2009)
 Global H2O (2009)
 Water-Culture Institute (2010)
 Dig Deep (2012)
 Human Right 2 Water (2020)

Other types of GWIs (water assessment, projects and research platforms)

World Water Assessment Programme (WWAP)
 GIWA (ended)
 International Water Assessment Centre | UNECE
 International Water and Environmental Assessments
 Water Resources Assessment—International Water Association
 Transboundary Waters Assessment Programme (TWAP)

International Water & Environmental Assessments
 Towards a Worldwide Assessment of Freshwater
 International Groundwater Resources Assessment Centre
 The Water Footprint Assessment Manual, SECOND ASSESSMENT—Sustainable Development Goals
 Comprehensive Assessment of Water Management in Agriculture
 Global Water Futures Program (GWF)
 Water Future Sustainable Water Future Programme (Future earth)
 Global Water Pathogen Project (UNESCO) (from 2010)

Appendix B. UN-Water Organizations

These UN-WATER intergovernmental organizations (IGOs) have been identified as influential in the global water initiatives landscape and are listed alphabetically in this appendix.

Convention on Biological Diversity
 Dept. of Economic and Social Affairs
 Food and Agriculture Organization of the United Nations
 IAEA
 IFAD
 ILO
 International Organization for Migration (IOM)
 ITU
 United Nations Human Rights, Office of the High Commissioner
 UNCTAD
 UN Convention to Combat Desertification
 UNDP
 United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)
 United Nations ESCWA
 United Nations Commission for Africa
 UNECE
 CEPAL
 UNESCO
 UNEP
 United Nations Framework Convention on Climate Change
 UNHCR
 UNIDO
 United Nations Institute for Training and Research (UNITAR)
 UNICEF
 UN Office for Disaster Risk Reduction (UNDRR)
 United Nations Entity for Gender Equality and the Empowerment of Women (UN Women)
 UNWTO
 UN-Habitat
 United Nations University (UNU)
 The World Bank
 World Food Program (WFP)
 World Health Organization (WHO)
 World Meteorological Organisation (WMO)

UN-Water Partners with Special Status (listed alphabetically).

Green Climate Fund
 Human Rights to Water and Sanitation, UN Special Rapporteur
 Sanitation and Water For All
 The Global Compact
 The Sanitation Hygiene Fund (SHF)

UN-Water Partners (listed alphabetically).

AquaFed (The International Federation of Private Water Operators)
CAWST
CDP (Disclosure Insight Action)
Conservation International
Gender and Water Alliance (GWA)
Global Water Partnership (GWP)
Human Right 2 Water
IAH
IAHR
IAHS
ICID
IGRAC
IHE Delft
International Hydropower Association (IHA)
International Institute for Applied Systems Analysis (IIASA)
International Institute for Sustainable Development
IRC (Supporting water sanitation and hygiene services for life)
IUCN
IWA
IWMI
IWRA
Public Services International
Ramsar
Rural Water Supply Network (RWSN)
SIWI
Stakeholder Forum for a Sustainable Future
Toilet Board Coalition
UNEP
UNESCO
UNHCR
UNIDO
United Cities and Local Governments
United Nations Framework Convention on Climate Change
Water Environment Federation (the water quality people)
Water.org
WaterAid
WBCSD
WCCE
Women for Water Partnership
World Youth Parliament for Water
WRI
WWC
WWF

Appendix C. Text Analysis of Declarations

Text in the declarations was coded using Dedoose software[®] (version 9.0.46, SocioCultural Research Consultants, LLC, Los Angeles, CA, USA), a qualitative data management tool for excerpting, coding, and analyzing text. The number of excerpts coded and total length of coded text for declaration is tabulated in Table A1.

Table A1. List of declarations coded for analysis with the number of coded excerpts and total length of coded text for each declaration. All table entries are based on exhaustive searches of literature and Internet.

Document Name	Year	Count of Excerpts	Total Length of Coded Text
Mar del Plata	1977	41	6937
Dublin Statement	1992	20	1836
Marrakesh Declaration	1997	5	334
Paris Declaration on Water and Sustainable Development	1998	24	1056
Hague Declaration	2000	18	985
Intl Conference on Freshwater Ministerial Declaration	2001	14	925
Indigenous Declaration on Water	2001	6	527
WHO Right to Water	2003	14	1148
Kyoto Water Declaration	2003	6	352
Bonn Charter	2004	10	350
Marseille Declaration	2012	27	2664
Delft Statement	2013	5	536
Bonn Water Declaration	2013	16	824
The Lisbon Charter	2015	34	2070
Budapest Summit Declaration	2016	9	1437
Rome Declaration on the Human Right to Water	2017	15	995
IWRA Cancun Declaration	2017	8	432
World Water Forum Ministerial Declaration	2018	24	1017
Budapest Appeal	2019	11	537
Brasilia Declaration of Judges on Water Justice	2018	23	1679
The Water and Open Government Declaration	2020	10	543
Dakar Declaration	2022	5	411

Initial coding was performed based on a list of terms in the following categories: actors, governance elements, system attributes, and system pressures and impacts. Codes belonging to each of these categories are listed in Table A2. Coding was performed iteratively, allowing for new codes to emerge from the text. Results were analyzed by examining the presence and frequency of codes (normalized by total length of coded text in each document) for each declaration.

Table A2. Codes used for text analysis of declarations across four categories.

Category	Codes
actors	basin authorities/RBOs civil society government international organizations judges and lawyers less developed countries NGOs
	private sector researchers vulnerable populations water suppliers women youth

Table A2. Cont.

Category	Codes		
governance	accountability	MDGs/SDGs	
	adaptive	network	
	capacity	open government	
	capital/investment	participatory	
	climate adaptation/mitigation	partnership	
	collaborative	planning	
	collective vision	policy	
	conflict	political will	
	consensus	polluter pays	
	cooperation	practice	
	coordination	prevent harm	
	cost	public good	
	data	resilience	
	decision	science	
	dialogue	social norm	
	economic growth	social value	
	economic value	solidarity	
	education	sovereignty	
	effective management	spiritual value	
	finances	standards	
	good governance/governance	subsidiarity	
	inclusion	system	
	information	technology	
integrated	transparency		
integrity	transboundary		
interdisciplinary	trust		
international agreements	water culture		
IWRM	watershed		
knowledge			
knowledge sharing			
law/legal provision			
attribute	access	nexus	
	affordability	peace and stability	
	efficient water use	poverty	
	environmental safeguards	conserve water resources	
	equity/equality	reliable	
	food security	rights	
	future generations	safe drinking water	
	green economy	sanitation	
	health	sustainability	
	human right	sustainable development	
	infrastructure	water quality	
	justice	water security	
	livelihoods	water supply	
	natural capital	well-being	
	pressures/impacts	agriculture	land
		biodiversity	marine environment
climate		natural disasters	
desertification		pollution	
development		population growth	
ecology/ecosystems		recreation	
environment		urban development	
globalization		wastewater	
hydropower		water demand	
industry		water recycling	
irrigation			

References

1. Varady, R.G.; Meehan, K. A flood of institutions? Sustaining global water initiatives. *Water Resour. Impact* **2006**, *8*, 19–22.
2. Varady, R.G.; Meehan, K.; Rodda, J.; McGovern, E.; Iles-Shih, M. Strengthening Global Water Initiatives. *Environ. Sci. Policy Sustain. Dev.* **2008**, *50*, 18–31. [\[CrossRef\]](#)
3. Varady, R.G.; Iles-Shih, M. Global Water Initiatives: What do the experts think? Report on a survey of leading figures in the ‘World of Water’. In *Impacts of Megaconferences on the Water Sector*; Biswas, A.K., Tortajada, C., Eds.; Springer: Berlin/Heidelberg, Germany, 2009; pp. 53–101.
4. Rijsberman, F.R.; Cosgrove, W.J. *World Water Vision: Making Water Everybody’s Business*; World Water Council/Earthscan Publications: Marseille, France, 2000; 108p.
5. Shuttleworth, W.J. New worldwide hydrological initiative needed. *Eos* **1999**, *80*, 103. [\[CrossRef\]](#)
6. Nace, R.L. Status of the International Hydrological Decade. *J. Am. Water Work. Assoc.* **1965**, *57*, 819–823. [\[CrossRef\]](#)
7. De Haar, U. The International Hydrological Decade. *Nature* **1965**, *207*, 920.
8. Batisse, M. *The UNESCO Water Adventure, from Desert to Water 1948–1974: From the “Arid Zone Programme to the International Hydrological Decade”*; UNESCO: Paris, France, 2005; 191p.
9. Kabat, P.; van Schaik, H. Reflections of Dialogue on Water & Climate After the 3rd [2003] World Water Forum in Kyoto. In *International Secretariat of the Dialogue on Water and Climate Report (ISDWC)*; Delft Digital Press: Delft, The Netherlands, 2004; 72p.
10. Varady, R.G.; Meehan, K.; McGovern, E. Charting the emergence of ‘global water initiatives’ in world water governance. *Phys. Chem. Earth Parts A B C* **2009**, *34*, 150–155. [\[CrossRef\]](#)
11. Varady, R.G. Global water initiatives: Their evolution and significance. IAHR/AIRH (formerly International Association for Hydraulic Research). *Newsletter* **2004**, *42*, 22.
12. Allan, J.A. Water in the environment/Socio-economic development discourse: Sustainability, changing management paradigms and policy responses in a global system. *Gov. Oppos.* **2005**, *40*, 181–199. [\[CrossRef\]](#)
13. Bakker, K. Water security: Research challenges and opportunities. *Science* **2012**, *337*, 914–915. [\[CrossRef\]](#)
14. Biswas, A.K.; Tortajada, C. *Impacts of Megaconferences on the Water Sector*; Springer: Berlin/Heidelberg, Germany, 2009; 276p.
15. Brooks, D.B. Beyond greater efficiency: The concept of water soft paths. *J. Can. Water Resour.* **2005**, *30*, 83–92. [\[CrossRef\]](#)
16. Conca, K.; Weinthal, E. *Oxford Handbook of Water Politics and Policy*; Oxford University Press: New York, NY, USA, 2018; 714p.
17. Gupta, J.; Akhmouch, A.; Cosgrove, W.; Hurwitz, Z.; Maestu, J.; Ünver, O. Policymakers’ reflections on water governance issues. *Ecol. Soc.* **2013**, *18*, 1. [\[CrossRef\]](#)
18. Pahl-Wostl, C.; Gupta, J.; Petry, D. Governance and the global water system: A theoretical exploration. *Glob. Gov.* **2008**, *14*, 419–435. [\[CrossRef\]](#)
19. Heikkilä, T.; Gerlak, A.K. Working on learning: How the institutional rules of environmental governance matter. *J. Environ. Plan. Manag.* **2018**, *62*, 106–123. [\[CrossRef\]](#)
20. Hoekstra, A.Y.; Chapagain, A.K. *Globalization of Water: Sharing the Planet’s Freshwater Resources*; Blackwell Publishing: Oxford, UK, 2008.
21. Molle, F. Nirvana concepts, narratives and policy models: Insights from the water sector. *Water Altern.* **2008**, *1*, 131–156.
22. Mukhtarov, F. A review of water policies on the move: Diffusion, transfer, translation or branding? *Water Altern.* **2022**, *2*, 290–306.
23. Pahl-Wostl, C. An evolutionary perspective on water governance: From understanding to transformation. *Water Resour. Manag.* **2017**, *31*, 2917–2932. [\[CrossRef\]](#)
24. Rogers, P.; Hall, A.W. *Effective Water Governance*; TEC Background Papers, No. 7; Global Water Partnership Technical Committee (TEC): Stockholm, Sweden, 2003; 47p.
25. Young, O.R. *Institutional Dynamics—Emergent Patterns in International Environmental Governance*; The MIT Press: Cambridge, MA, USA, 2010; 240p.
26. Baumgartner, T.; Pahl-Wostl, C. UN–Water and its Role in Global Water Governance. *Ecol. Soc.* **2013**, *18*, 16. [\[CrossRef\]](#)
27. Araral, E.; Wang, Y. Water Governance 2.0: A Review and Second Generation Research Agenda. *Water Resour. Manag.* **2013**, *27*, 3945–3957. [\[CrossRef\]](#)
28. Tropp, H. Water governance: Trends and needs for new capacity development. *Water Policy* **2007**, *9*, 19–30. [\[CrossRef\]](#)
29. Woodhouse, P.; Muller, M. Water Governance—An Historical Perspective on Current Debates. *World Dev.* **2017**, *92*, 225–241. [\[CrossRef\]](#)
30. Milich, L.; Varady, R.G. Openness, sustainability, and public participation: New designs for transboundary river-basin institutions. *J. Environ. Devt.* **1999**, *8*, 258–306. [\[CrossRef\]](#)
31. Rodda, J.C. Whither world water? *Water Resour. Bull.* **1995**, *31*, 1–7. [\[CrossRef\]](#)
32. Taylor, D.C. The role of professional societies in the dissemination of water resources research information. In *Transfer of Water Resources Knowledge*; Vlachos, E., Ed.; Water Resources Publications: Fort Collins, CO, USA, 1973.
33. Kaplan, K. Professional societies: Come together. *Nature* **2013**, *502*, 581–583. [\[CrossRef\]](#) [\[PubMed\]](#)
34. United Nations. *Report of the United Nations Conference on the Human Environment, Stockholm, 5–16 June 1972*; United Nations: New York, NY, USA, 1973; 77p.
35. United Nations. *Report of the United Nations Water Conference Mar del Plata, 14–25 March 1977*; United Nations: New York, NY, USA, 1977; 77p.

36. Najlis, P.; Kuylenstierna, J.L. Twenty Years After Mar Del Plata—Where Do We Stand and Where Do We Go? In Proceedings of the Mar Del Plata 20 Year Anniversary Seminar: Water for the Next 30 Years—Averting the Looming Water Crisis, Stockholm, Sweden, 16 August 1997; Stockholm International Water Institute: Stockholm, Sweden, 1997; p. 23.
37. Fritsch, O.; Benson, D. Mutual Learning and Policy Transfer in Integrated Water Resources Management: A Research Agenda. *Water* **2020**, *12*, 72. [[CrossRef](#)]
38. ICSU (International Council for Science). *A Framework for the International Polar Year 2007–2008*; ICSU: Paris, France, 2004; p. 57.
39. Odishaw, H. International Geophysical Year: A report on the United States program. *Science* **1958**, *127*, 115–128. [[CrossRef](#)]
40. The White House. *Remarks by the President in connection with the opening of the International Geophysical Year*; The White House Press Release: Washington, DC, USA, 1957; 1p.
41. Salman-Salman, M.A. From Marrakech through The Hague to Kyoto: Has the global debate on water reached a dead end? Part Two. *Water Int.* **2004**, *29*, 11–19. [[CrossRef](#)]
42. Speth, J.G. Perspectives on the Johannesburg Summit. *Environment* **2003**, *45*, 25–29.
43. Falkenmark, M. Ten year message from previous symposia. *Water Sci. Technol.* **2001**, *43*, 13–15. [[CrossRef](#)]
44. Varady, R.G.; Albrecht, T.; Staddon, C.; Gerlak, A.K.; Zuniga-Teran, A.A. The water security discourse and its main actors. In *Handbook of Water Resources Management: Discourses, Concepts, and Examples*; Bogardi, J.J., Tingsanchali, T., Nandalal, K.D.W., Gupta, J., Salamé, L., van Nooijen, R.R.P., Kolechkina, A.G., Kumar, N., Bhaduri, A., Eds.; Springer: Berlin/Heidelberg, Germany, 2021; pp. 215–252.
45. Reinicke, W.H. The other World Wide Web: Global public policy networks. *Foreign Policy* **1999**, *117*, 44–57. [[CrossRef](#)]
46. Stone, D. Transfer agents and the global networks in the “transnationalization” of policy. *J. Eur. Public Policy* **2004**, *11*, 545–566. [[CrossRef](#)]
47. Paterson, M. Exploring Global Governance Networks. Analysis, Newsletter of the Center for International Policy Studies, 7 March 2012. Available online: <https://www.cips-cepi.ca/2012/03/07/exploring-global-governance-networks/> (accessed on 19 September 2022).
48. Mukhtarov, F.; Gerlak, A.K. Epistemic forms of integrated water resources management: Towards knowledge versatility. *Policy Sci.* **2013**, *47*, 101–120. [[CrossRef](#)]
49. Taing, L. Is safe water, sanitation, and hygiene a pipe dream? *One Earth* **2022**, *5*, 126–128. [[CrossRef](#)]
50. Wichelns, D. The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective? *Environ. Sci. Policy* **2017**, *69*, 113–123. [[CrossRef](#)]
51. Gerlak, A.K.; Wilder, M. Exploring the Textured Landscape of Water Insecurity and the Human Right to Water. *Environ. Sci. Policy Sustain. Dev.* **2012**, *54*, 4–17. [[CrossRef](#)]
52. Zeitoun, M.; Mirumachi, N.; Warner, J.; Kirkegaard, M.; Cascão, A. Analysis for water conflict transformation. *Water Int.* **2019**, *45*, 365–384. [[CrossRef](#)]
53. Varady, R.G.; Gerlak, A.K.; Wilder, M.O.; Pablos, N.P. Ruminations and insights on hydrodiplomacy. *Environ. Sci. Policy* **2021**, *124*, 55–63. [[CrossRef](#)]
54. Wilder, M.O.; Varady, R.G.; Mumme, S.P.; Gerlak, A.K.; Flessa, K.W.; Zuñiga, A.; Scott, C.A.; Pablos, N.P.; Megdal, S.B. Hydrodiplomacy and adaptive governance at the U.S.-Mexico border: 75 years of tradition and innovation in transboundary water management. *Environ. Sci. Policy* **2020**, *112*, 189–202. [[CrossRef](#)]
55. Milman, A.; Gerlak, A.K. International river basin organizations, science, and hydrodiplomacy. *Environ. Sci. Policy* **2020**, *107*, 137–149. [[CrossRef](#)]
56. United Nations World Water Day 22 March 2022. Available online: <https://www.un.org/en/observances/water-day> (accessed on 28 August 2022).
57. Lovins, A. *Soft Energy Paths: Toward a Durable Peace*; Harper Colophon Books: New York, NY, USA, 1977; p. 231.
58. Haas, P. Introduction: Epistemic communities and international policy coordination. *Int. Organ.* **1992**, *46*, 1–35. [[CrossRef](#)]
59. Conca, K. *Governing Water: Contentious Transnational Politics and Global Institution Building*; MIT Press: Cambridge, MA, USA, 2006; p. 466.
60. Varady, R.G.; Gerlak, A.K.; Wilder, M.O.; Pineda, N. (Eds.) New Directions in Hydrodiplomacy to Meet Global Water Challenges: Learning from the Past, Shaping the Future. *Environ. Sci. Policy* **2021**, *124*, 55–63. Available online: <https://www.sciencedirect.com/journal/environmental-science-and-policy/special-issue/10SXF1D7BGN> (accessed on 28 August 2022).
61. Lane, J. Global water conferences: A personal reflection. In *Impacts of Megaconferences on the Water Sector*; Biswas, A.K., Tortajada, C., Eds.; Springer: Berlin/Heidelberg, Germany, 2009; pp. 103–108.
62. Seyfang, G. Environmental mega-conferences—From Stockholm to Johannesburg and beyond. *Glob. Environ. Chang.* **2003**, *13*, 223–228. [[CrossRef](#)]
63. Varady, R.G.; Wilder, M.; Eden, S.; Browning-Aiken, A.; Jacobs, K.; Valdes, J. ‘Mega-networking’ at the Fourth World Water Forum in Mexico City: Looking for opportunities at a megaconference. *Ariz. Water Resour.* **2006**, *14*, 6.
64. Gleick, P.H.; Lane, J. Large International Water Meetings: Time for a Reappraisal. *Water Int.* **2005**, *30*, 410–414. [[CrossRef](#)]
65. Ingram, H. Doing better and delivering worse: Pathology of water experts. In *Water Governance, Policy and Knowledge Transfer: International Studies on Contextual Water Management*; de Boer, C., Vinke-de Kruijf, J., Özerol, G., Bressers, H., Eds.; Routledge: London, UK, 2013; pp. 13–15.

66. Asamoah, O.Y. Significance of declarations in international organizations. In *The Legal Significance of the Declarations of the General Assembly of the United Nations*; Springer: Dordrecht, The Netherlands, 1966; pp. 235–240.
67. Savić, D.A.; Walters, G.A. Evolving sustainable water networks. *Hydrol. Sci. J.* **1997**, *42*, 549–564. [[CrossRef](#)]
68. Lemos, M.C.; Agrawal, A. Environmental governance. *Annu. Rev. Environ. Resour.* **2006**, *31*, 3.1–3.29. [[CrossRef](#)]
69. Biermann, F.; Pattberg, P. *Global Environmental Governance Reconsidered*; MIT Press: Cambridge, MA, USA, 2012; 301p.
70. Kramer, A.; Pahl-Wostl, C. The global policy network behind integrated water resources management: Is it an effective norm diffusor? *Ecol. Soc.* **2014**, *19*, 11.
71. Islam, S.; Susskind, L.E. *Water Diplomacy: A Negotiated Approach to Managing Complex Water Networks*; Routledge: New York, NY, USA, 2012; p. 352.
72. Newton, J.T. “Water, water everywhere, nor any drop to drink”: An exploration of the lack of a formal global water governance regime. Ph.D. Thesis, Fletcher School of Law and Diplomacy, Tufts University, Medford, MA, USA, 2014; p. 327.
73. Pahl-Wostl, C.; Craps, M.; Dewulf, A.; Mostert, E.; Tabara, D.; Taillieu, T. Social learning and water resources management. *Ecol. Soc.* **2007**, *12*, 19. [[CrossRef](#)]
74. Pahl-Wostl, C.; Mostert, E.; Tabara, J.D. The Growing Importance of Social Learning in Water Resources Management and Sustainability Science. *Ecol. Soc.* **2008**, *13*, 24. [[CrossRef](#)]
75. Lemos, M.C.; Morehouse, B.J. The co-production of science and policy in integrated climate assessments. *Glob. Environ. Chang.* **2005**, *15*, 57–68. [[CrossRef](#)]
76. Grigg, N.S. Fifty years of water research: Has it made a difference? *Water Int.* **2021**, *46*, 1087–1098. [[CrossRef](#)]
77. Wang, M.-H.; Yu, T.-C.; Ho, Y.-S. A bibliometric analysis of the performance of Water Research. *Scientometrics* **2010**, *84*, 813–820. [[CrossRef](#)]
78. Dennis, L.E.; Grady, C.A. Watery research boundaries: A bibliometric and network science approach to explore gaps and overlaps in water research. *Water Secur.* **2022**, *16*, 100117. [[CrossRef](#)]
79. Wescoat, J., Jr. Comparative international water research. *J. Contemp. Water Res. Educ* **2009**, *142*, 61–66. [[CrossRef](#)]
80. UNESCO. *Water, People and Cooperation: 50 Years of Water Programmes for Sustainable Development at UNESCO*; UNESCO: Paris, France, 2015; p. 250.
81. UNESCO from Potential Conflict to Cooperation Potential. 2022. Available online: <https://groundwaterportal.net/project/pccp> (accessed on 28 August 2022).
82. UNESCO. *IHP-IX Strategic Plan of the Intergovernmental Hydrological Programme: Science for a Water Secure World in a Changing Environment. Ninth Phase 2022–2029*; UNESCO: Paris, France, 2015; p. 51.
83. Milburn, A. International Water Conferences and Water Sector Reform: A Different Approach. In *Impacts of Megaconferences on the Water Sector*; Biswas, A.K., Tortajada, C., Eds.; Springer: Berlin/Heidelberg, Germany, 2009; pp. 109–125.
84. Keen, M.; Ratynska, A. *External Review of UN-Water Final Report*; International Organisation Development (IOD) Ltd.: Sheffield, UK, 2009; p. 70.
85. UN-Water. About UN-Water. 2022. Available online: <https://www.unwater.org/about-un-water> (accessed on 28 August 2022).
86. Wiegleb, V.; Bruns, A. Hydro-social arrangements and paradigmatic change in water governance: An analysis of the sustainable development goals (SDGs). *Sustain. Sci.* **2017**, *13*, 1155–1166. [[CrossRef](#)]
87. Swann, P.; André, N. *External Review of UN-Water Final Report*; Swann Consulting: Peregrine Canterbury, UK, 2018; p. 52.
88. Newton, J.T. UN-Water Programmes External Evaluation. 2014; *Unpublished Work*.
89. Pahl-Wostl, C.; Conca, K.; Kramer, A.; Maestu, J.; Schmidt, F. 2 Missing links in global water governance: A processes-oriented analysis. *Ecol. Soc.* **2013**, *18*, 2. [[CrossRef](#)]
90. Haverland, A.C. Considering Climate Change Through Global Water Initiatives. Ph.D. Thesis, University of Arizona, Tucson, AZ, USA, 2015.