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Water conflict analysis in a changing context: A qualitative systematic review of trends, patterns, and approaches in Iran

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Abstract

Foremost in dealing effectively with water conflicts is comprehensive analysis. The global surge in water conflicts, coupled with the imperfect success of solutions, initiatives, and policies, calls for a critical reevaluation of the paradigms that guide approaches to water conflicts. The approach taken—conflict management, resolution, or transformation—has a decisive impact on addressing water conflicts, from the initial analysis to the crafting of policies and their practical implementation. Iran is a prime example of this, with water conflicts increasing at various scales despite concerted mitigation efforts. This paper, through a qualitative content analysis of 159 peer-reviewed papers collected via a systematic review, aims to delineate the prevailing approach to water conflict analysis within Iran's academic discourse, thereby partially shedding light on the shortcomings in both policy and practice. Water conflict resolution, and its respective models such as game theory and optimization–simulation, is the predominant approach in Iran's literature on water conflict analysis, thereby marginalizing attention dedicated to conflict management and transformation. This reflects an overarching focus on techno-economic functions to deal with water conflicts, often overlooking the

myriads of managerial and societal factors. The adoption of water conflict transformation can be vital to rectify these deficits in conflict analysis, potentially with subsequent impacts on policy and practice.

KEYWORDS
conflict analysis, conflict resolution, game theory, techno-economic solutions

1 | INTRODUCTION

Water resource management is, by its very nature, a complex and conflict-prone process (Grandi, 2016; Mamasani et al., 2024; Wolf, 1995). Over recent decades, the world has witnessed a rapid surge in both the incidence of and scholarly attention to water conflicts, both in subnational and international scales (Gleick & Shimabuku, 2023; Kåresdotter et al., 2023). This global proliferation in water conflicts has significantly impacted human well-being, public health, and economic prosperity (Abukhater, 2013; Ardestani et al., 2024; Kramer, 2004; Kreamer, 2012). The effects are particularly acute in water-scarce regions such as West Asia, which have witnessed an escalation in environmentally forced migrations, weaponization of water, damage to hydraulic infrastructures, and an upsetting escalation in water conflict incidents (Erande, 2016; Gleick, 2019; Hussein, 2023; Mianabadi et al., 2022; Nagabhatla et al., 2021). In light of these pressing challenges, it is imperative to deal effectively and constructively with water conflicts.

At the heart of efforts to deal with water conflicts lies conflict analysis (Zeitoun et al., 2020). Whether at the local or global level, water conflicts involve a complex tapestry of interests, regulations, issues, hierarchies, and power structures that are constantly changing (Islam & Susskind, 2018; Liu et al., 2007). These factors are not merely influential; they also encompass discourses (Bréthaut et al., 2021; Menga & Mirumachi, 2016), emotions (Mamasani et al., 2024; Seide & Fantini, 2023), identities (Kalpakian, 2017; Nagheeby & Warner, 2022), and norms (Browder & Ortolano, 2000; Cascão & Nicol, 2016), contributing to the complexity and intractability of water conflicts. All of these aspects concurrently impact the onset and exacerbation of water conflicts (Nagheeby & Amezaga, 2023; Sehring & Wolf, 2023). More comprehensive conflict analysis from the outset leads to constructive solutions to water conflict when ultimately put into practice.

The choice of an appropriate "approach" to water conflicts is crucial for thorough analysis and effective practice (Zeitoun et al., 2014, 2020). Among various approaches and mindsets, conflict management, resolution, and transformation have emerged as dominant, shaping research, practice, and policy development (Reimer et al., 2015; Richmond, 2002).[1] These approaches lead to a focus on different sets of influential factors—conflict management often relies on legal analyses (Delli-Priscoli & Wolf, 2009), conflict resolution stems from cost–benefit analysis (Tayia, 2019), and conflict transformation is based on identifying structural and attitudinal contexts (Sehring & Wolf, 2023; Zeitoun et al., 2020). While conflict resolution and

transformation aim at eliminating conflict and forging the relational structure, respectively (Lederach, 2003; Wallensteen, 1991), conflict management seeks to neutralize and regulate conflict escalation and its consequential impacts (Aiyede, 2006; Miall, 2004). Therefore, it is crucial to reassess the approach taken in water conflict analysis and adopt the one most likely to achieve the desired outcome.

Iran is, in particular, with its arid and semi-arid climate, a prime example of the growing global trend of escalating water conflicts. Despite concerted efforts and the implementation of mitigation measures, water conflicts in Iran have continued to rise significantly in both frequency and intensity (Ahmadi et al., 2018; Avarideh et al., 2017; Bijani et al., 2020; Madani et al., 2014; Mamasani et al., 2024; Mianabadi et al., 2021; Nagheeby & Warner, 2022; Safavi et al., 2016; Zarghami et al., 2015). Iran's experience highlights a multi-scalar escalation of water conflicts, intensifying tensions across various levels of social and political organizations. The effectiveness of proposed solutions to water conflicts hinges on the approach taken in conflict analysis; notwithstanding, water conflict research in Iran has been criticized for its use of analytical frameworks without considering the overarching approach (Farajzade Arnesa et al., 2021; Fasihi Harandi, 2018; Jafari et al., 2022). These gaps have the potential to pose an impediment to the efficacious dealing with water conflicts. Despite these challenges, there is still a notable absence of systematic examinations regarding prevailing approaches and their implications in water conflict research within Iran.

This gap is not exclusive to Iran but extends as a broader issue globally, underscoring the necessity for a reassessment of prevailing approaches to water conflict analysis. This paper addresses a significant gap in knowledge concerning water conflict analysis, specifically focusing on Iran. This study systematically reviews existing literature and conducts qualitative content analysis on a substantial sample to unpack the prevailing approaches, trends, and patterns in Iran's water conflict research. The methods section describes the process of systematic review and variables for data extraction. Subsequently, the results critically examines and discusses the approaches beyond the models and frameworks employed, assesses their coverage of conflict-generating issues across different scales, and identifies the trends and patterns of adopting approaches in Iran's literature of water conflict studies. Ultimately, this paper seeks to provide valuable insights into water conflict studies, particularly within the context of Iran and lay the groundwork for more comprehensive and effective conflict analysis on both subnational and international scales.

2 | STUDY AREA

Iran accounts for 0.36% of the world's freshwater resources, with nearly 1.09% of the total land area and 1.11% of the global population (Sobhani et al., 2022). As depicted in Figure 1, Iran comprises six main river basins and 30 subbasins, covering a total area of 1,622,941.6 km^2 (Table 1). Of these, the Central Plateau stands out as the sole main basin that is entirely subnational, while others generally consist of a mix of subnational and transboundary river basins. The majority of Iran's population resides in Central Iran, facing challenges in water accessibility due to the arid and semi-arid climate (Darbandsari et al., 2020; Enteshari & Safavi, 2019). The average annual precipitation is 25 cm, with evaporation rates 10 times higher (Afshar & Fahmi, 2019). Moreover, there is an uneven distribution of precipitation and discharge among the subbasins, often misaligned with water requirements (Darand & Mansouri Daneshvar, 2014).

Water conflicts in Iran, whether subnational or international, are complex and highly context specific. Water conflicts have become intertwined with a variety of societal, economic, and

FIGURE 1 Main river basins and subbasins of Iran.

governance issues within Iran's borders, as well as multifaceted issues with neighboring countries. Factors such as the distribution of water in subnational basins among different interest groups, environmental conservation efforts, and governmental interference all contribute to water conflicts. They can manifest in different forms, ranging from economic and structural conflicts to emotionally charged, identity-driven clashes over water resources (Jafari, 2023; Mamasani, 2024; Safaee & Malekmohammadi, 2014). Consequently, the causes of subnational water conflicts in Iran are highly context dependent; various challenges and factors intersect with the distribution, access, and utilization of water.

Transboundary water issues vary across different regions, presenting complex challenges in transboundary water governance. Iran is downstream in its eastern and northwestern regions and upstream in the west. This dual positioning exposes Iran to distinct challenges. When situated downstream, Iran faces hydropolitical issues with upstream countries, including hydraulic missions in Türkiye and Afghanistan and actions that have contributed to water scarcity, environmental degradation, dust storm events, sociopolitical harms, and population displacements (Dadparvar et al., 2024; Dowlatabadi et al., 2020; Ghoreishi et al., 2020, 2023, 2024; Mianabadi et al., 2021; Nagheeby & Warner, 2022; Nagheeby et al., 2019). Conversely, when Iran is upstream, it encounters legal disputes with downstream countries. The complexity of Iran's

TABLE 1 Classification and hydro-climatic features of river basins in Iran.[a]

Main river basins	Total area (km^2)	Subbasins	ID	Area (km^2)	Mean annual precipitation (cm/yr)	Mean annual discharge (cm/yr)
Caspian Sea	175,060	Aras	11	39,778.8	16.5	6.5
		Talesh-Anzali Lagoon	12	7,036.3	51.5	50.9
		Sefidrud	13	59,194.1	26.5	5.5
		Haraz-Sefidroud	14	10,893.4	27.0	15.5
		Haraz	15	18,774.9	31.0	18.5
		Gorgan-Gharesoo	16	12,986.9	15.5	3.5
		Atrak	17	26,395.7	17.0	1.5
Persian Gulf and Oman Sea	424,029.6	Western Border	21	39,297.8	32.5	9.0
		Karkheh	22	51,912.3	30.5	7.0
		Karun-e Bozorg	23	66,675.9	40.5	23.0
		Zohre-Jarahi	24	40,820.8	23.5	9.5
		Helle	25	21,309.1	21.0	3.5
		Mand	26	47,802	18.5	1.5
		Mehran-Kal	27	62,895.8	13.5	1.0
		Bandar Abbas	28	44,792.2	9.5	0.5
		South Baluchestan	29	48,523.7	10.5	0.2
Lake Urmia	51,761.9	Lake Urmia	30	51,761.9	23.0	0.0
Central Plateau	824,611.4	Namak Lake	41	92,884.2	19.5	2.0
		Gavkhuni	42	41,552.3	13.0	0.4
		Tashk-Bakhtegan	43	31,451.9	20.5	2.0
		Abarghoo-Sirjan	44	57,125.3	11.0	0.2
		Hamoun-e Jazmourian	45	69,374.8	10.5	0.5
		Lut Desert	46	206,354	9.5	0.3
		Central Desert	47	226,533.1	13.5	0.8
		Siahkooh	48	48,599.1	6.0	0.3
		Saghand	49	50,736.5	11.5	0.8

(Continues)

TABLE 1 (Continued)

Main river basins	Total area (km^2)	Subbasins	ID	Area (km^2)	Mean annual precipitation (cm/yr)	Mean annual discharge (cm/yr)
Eastern Border	103,183.2	Khaf-Namakzar	51	33,086	12.5	0.8
		Hamun-e Hirmand	52	33,589.6	4.0	0.2
		Hamun-e Mashkel	53	36,507.6	8.0	0.2
Karakum	44,295.5	Karakum	60	44,295.5	20.5	3.0

[a]The classification of the basins, subbasins, and their area is based on Iran's Ministry of Energy (2002), and the data for mean annual precipitation and discharge are based on Saemian et al. (2022).

hydropolitical issues is exemplified by the Tigris River, where Iran is located upstream but has been significantly impacted by environmental issues (Banihabib & Dowlatabadi, 2017). The water conflicts unfold within a unique context in Iran, differing in scale and influenced by a complex tapestry of constantly evolving factors.

Considering the complex and context-specific nature of water conflicts, conducting a systematic review of water conflict analysis in Iran is crucial. Such a review not only unpacks the prevailing approaches and models but also guides policies and solutions to mitigate adverse impacts on the well-being of conflict-affected societies. Comprehending Iran's water conflicts in an international context can also promote cooperation and sustainable water management practices, benefiting both national and regional stability and transboundary water governance.

3 | METHODS

This paper presents a systematic review of water conflict analysis in Iran to highlight the prevailing approaches used in the literature. The systematic review involves three stages: identification, screening, and selection (Booth et al., 2016). The research follows two protocols: the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021) and the Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) (Tong et al., 2012). Both data collection and analysis were conducted collaboratively using a triple-blinded approach to mitigate bias, involving three expert reviewers (MJ, BA, HM) and the critical support of four readers (AG, SNF, SC, SM).

3.1 | Eligibility criteria

We collected and qualitatively analyzed data from peer-reviewed papers in Iran's water conflict literature. To ensure the relevance of the identified studies, we developed predefined eligibility guidelines based on Booth et al. (2016). Papers were deemed eligible if they met the following criteria: no multiple publications or low-quality content; published up to 2022; written in English or Persian; having at least one Iranian coauthor; being original research or empirical studies rather than reviews or hypothetical papers; and focusing on study areas within Iran's

river basins. By adhering to these criteria, the systematic review included a representative collection of scientific papers reflecting scholarly discourse on water conflict analysis in Iran.

3.2 | Search strategy

The initial stage of a systematic review involves defining search strings by predefining keywords with sensitivity and specificity features (Booth et al., 2016). The primary part of the search string includes sensitivity keywords, followed by specificity keywords, combined using Boolean logic operators: "OR" within the same type of keywords and "AND" between different types, for example, (conflict OR dispute OR crisis OR cooperation OR diplomacy OR hydropolitics) AND (water OR Iran OR [name of river basins]). In addition to the English keywords, we included their Persian-language translations and common synonymous terms in scholarly literature.

The resulting search string was used to query scientific databases, including the American Society of Civil Engineers (ASCE), the Scientific Information Database (SID—the Iranian scientific database), the Directory of Open Access Journals (DOAJ), and Dimensions. Dimensions were preferred over Scopus and Web of Science due to two recent studies demonstrating its superior thematic and content coverage (Martín-Martín et al., 2020; Singh et al., 2021). To ensure comprehensive content coverage, we also employed hand-searching and citation-searching methods (Booth et al., 2016). Hand-searching involved conducting generic web searches and reviewing relevant journals to identify papers not indexed in the databases. Citation-searching was performed using Google Scholar, employing snowball sampling to find relevant papers by exploring references and citations.

3.3 | Screening process

The screening process was implemented in accordance with predefined eligibility criteria, which encompassed three sequential phases: title screening, abstract screening, and full-text screening. Two blinded reviewers, identified as MJ and BA, independently adjudicated on the eligibility of papers with two outcomes (yes, no) on the inclusion/exclusion of papers. Consensus decisions between the reviewers were considered final, while in cases of disagreement, a third reviewer (HM) was engaged as an arbitrator to determine the final decision. To prevent the inadvertent exclusion of qualified papers during the screening stages, a conservative sensitivity threshold was initially applied during the title screening phase. Subsequently, this threshold was heightened during both the abstract screening and, particularly, the full-text screening phases. This methodical approach ensured a systematic and non-random inclusion of eligible papers that successfully passed the triple-blinded screening process.

3.4 | Variables and data analysis

Qualitative content analysis serves as a method for data analysis and extraction aimed at refining raw information from the included papers into deductively derived, analyzable concepts (Booth et al., 2016; Dehhaghi et al., 2022). In this study, we delineated themes on approaches, research topics, scales, and models, formulating variables for each theme for the coding process.

The variables used to delineate approaches to water conflict are predicated on their objectives and strategies for addressing conflicts. Conflict management endeavors to neutralize, restrict, and control conflicts by advocating for agreements among involved parties based on self-interests (Aiyede, 2006; Miall, 2004; Richmond, 2002). Conflict resolution, on the other hand, seeks to eradicate conflicts by optimizing outcomes between concerned parties (Lederach, 2003; Wallensteen, 1991), while conflict transformation aims to foster constructive relations through structural changes in the context of conflict among stakeholders (Galtung, 1996; Lederach, 2003, 2005). The theories of conflict provide well-defined explanations of how water conflicts are approached within the given paper's scope[2]; the content analysis in this research is thus based on a priori framework of concepts in conflict management, resolution, and transformation.

After analyzing the included papers in the final repository, we identified six thematic areas that papers have focused on, each capable of engaging with one or more of them. One topic theme is water quantity, encompassing disputes related to access, allocation, and the availability of water resources. A second thematic focus is water quality, which delves into conflicts arising from contaminations and the allocation of waste loads. The third theme of investigation is water economics, which examines conflicts regarding the utilization of water resources to enhance economic prosperity. The fourth theme is water rights, entailing conflicts over ownership and usage of water resources based on traditional and customary law or legally established rights. The fifth theme is water governance, which centers around conflicts over policies and regulations in the management of water resources, as well as conflicts between different levels of government and stakeholders. The sixth topic theme is water infrastructure, which focuses on conflicts over the construction and operation of water infrastructure, such as dams, irrigation systems, and wastewater treatment stations.

The scale to which each paper has been tailored for the water conflict analysis in Iran is local, subnational, or international. Local-scale conflicts entail water-related disputes and contests between groups and communities located within the same jurisdiction, such as users around a specific irrigation network. At the subnational scales, conflicts manifest as water-related tensions between distinct social and political entities within a country, such as provinces and states. International-scale conflicts pertain to water-related disputes occurring between neighboring riparian countries. It is imperative to note that the scale of research on water conflicts is not inherently aligned with the geographical scale of river basins; for instance, studies may delve into local-scale issues within transboundary river basins.

The models and mechanisms of water conflict analysis entail a diverse spectrum of models, analytical frameworks, and associated components. This repertoire incorporates a myriad of models, including but not limited to game theory, optimization techniques, simulation procedures, network modeling approaches, legal frameworks, multi-criteria decision analysis (MCDA), hydropolitical paradigms, institutional frameworks, and market-based instruments. It is imperative to note that scholarly works may not use only one model and often necessitate the simultaneous utilization of multiple models such as optimization–simulation. Moreover, the judicious selection of models within the same category, such as variations of cooperative and noncooperative game theory, can be used so that the best answer is chosen among them.

The analysis was conducted using MAXQDA 2024 software, with input from three independent reviewers (MJ, BA, HM) and additional scrutiny from readers (AG, SNF, SC, SM) to ensure the accuracy and reliability of the findings. The reviewers identified and categorized propositions of approaches using the conceptual framework within each paper. The models, scales, and

river basins under investigation did not necessitate an extensive degree of analytical coding and were basically descriptive, and disagreements emerged only regarding approaches.

4 | RESULTS

4.1 | Search and screening results

The trio-method literature search conducted to investigate water conflicts in Iran resulted in the identification of 2799 papers. Of these, 89.39% ($n = 2502$) were identified through database searches and 10.61% ($n = 297$) were discovered through additional methods (Figure 2). Hand-searching accounted for identifying 26.94% ($n = 80$) of the papers, and citation-searching contributed to identifying 73.06% ($n = 217$) of them. At the initial stage, the process involved removing duplicate and review papers, leading to the exclusion of 23.50% ($n = 588$) of the papers initially identified through database searches. This left a total of 1914 papers for title screening, during which 69.23% ($n = 1325$) of the papers were eliminated, leaving 589 papers for the next stage. Further along, during the retrieval phase, 71.99% ($n = 424$) of the papers were not retrieved during abstract screening, and 27.27% ($n = 45$) were deemed ineligible in the full-text screening.

The papers identified through additional methods—hand-searching and citation-searching—do not require pre-screening removal or title screening as they have already been collected with those considerations. During abstract screening, 76.77% ($n = 228$) of the papers sought for retrieval were excluded, with an additional 31.25% ($n = 30$) of papers assessed for eligibility being excluded after full-text screening. The primary reasons for exclusion at this stage, both for database searching and additional methods, included the absence of water conflict analysis (45.33%, $n = 34$), the inclusion of non-peer-reviewed papers (mainly conference proceedings; 16.00%, $n = 12$), and duplicate papers identified through additional methods (12.00%, $n = 9$). In the end, 159 eligible papers (5.69% of the total papers identified) were included in the final repository, with 75.47% ($n = 120$) identified from database searches and 24.53% ($n = 39$) from other search methods.

During the screening process, reviewers (MJ, BA) exhibited an average agreement of 88.89% on their decisions—88.66% ($n = 1697$) in title screening, 92.44% ($n = 819$) in title screening, and 77.35% ($n = 181$) in full-text screening. The kappa coefficient for the two reviewers was 0.73, indicating a "substantial degree" of inter-rater agreement (see Landis & Koch, 1977). Throughout the screening process, 11.11% ($n = 337$) of papers appearing in each stage of screening were subject to arbitration by the third independent reviewer (HM). Among these, 66.17% ($n = 223$) of papers were decided to be included, while 33.83% ($n = 114$) of papers were decided to be excluded.

In the subsequent subsections, the trends, patterns, and interconnections among variables including approaches, models, and scales in water conflict analysis in Iran were delved into. First, a general overview of the literature was provided, encompassing both the volume of publications and the scales typically utilized in research. Subsequently, the specific topics covered in water conflict analyses and their varying importance across different subbasins were examined. The different approaches found in the literature were explored, with consideration given to their prevalence, their ties to geographical factors, and how effectively they addressed various water conflict issues. Finally, the focus was placed on the most commonly used models and

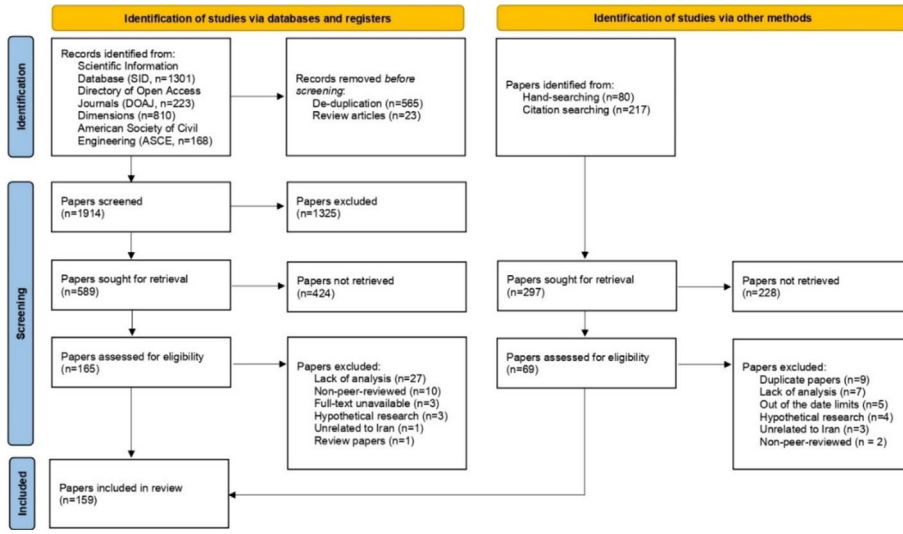

FIGURE 2 The PRISMA flow diagram of systematic literature review.

mechanisms, along with how they were distributed across river basins of Iran and their relevance to the approaches taken to water conflict analysis.

4.2 | An overview of water conflict studies in Iran

The papers analyzed in this research indicate an upward trajectory in studies on water conflicts in Iran, with a steady increase from the mid-2000s to the mid-2010s and rapid growth up to the early 2020s (Figure 3).[3] They also reveal that 65.41% ($n = 104$) were published in English, while 34.59% ($n = 55$) were in Persian. The temporal distribution of papers indicates a notable trend. Prior to the early 2010s, Persian-language publications were relatively scarce. However, this trend changed, with a notable increase in the number of Persian publications. In 2016, Persian papers surpassed English articles for the first and only time; since then, Iranian researchers have also favored publishing in English. The scale of water conflict studies also varied, with 42.77% ($n = 68$) focusing on the local scale, followed by 35.85% ($n = 57$) at the subnational scale and 21.38% ($n = 34$) on the international scale of water conflicts. The examination of local-scale water conflicts showed a gradual increase until the mid-2010s, followed by a marked acceleration leading up to the early 2020s. The emphasis on subnational water conflicts surged during the 2010s, while international water conflicts gained more prominence since the mid-2010s.

The analysis of water conflict trends across river basins presents a diverse research landscape (Figure 4). After reviewing the existing literature, a total of 168 case studies were coded, some of which included multiple cases. As the largest and only subnational river basin in Iran, the Central Plateau comprises 31.55% ($n = 53$) of the studies on water conflict in Iran, accounting for 40.15% ($n = 53$) of total publications on local and subnational scales. Among its subbasins, the Gavkhuni basin stands out with 41.51% ($n = 22$) of publications, encompassing 71.43% ($n = 15$) of subnational-scale water conflict analysis within the Central Plateau, followed by Namak Lake ($n = 14$, 26.42%) and Tashk-Bakhtegan and Maharloo Lakes ($n = 10$, 18.87%). Furthermore, attention to the Caspian Sea basin indicates a relatively emerging area of research

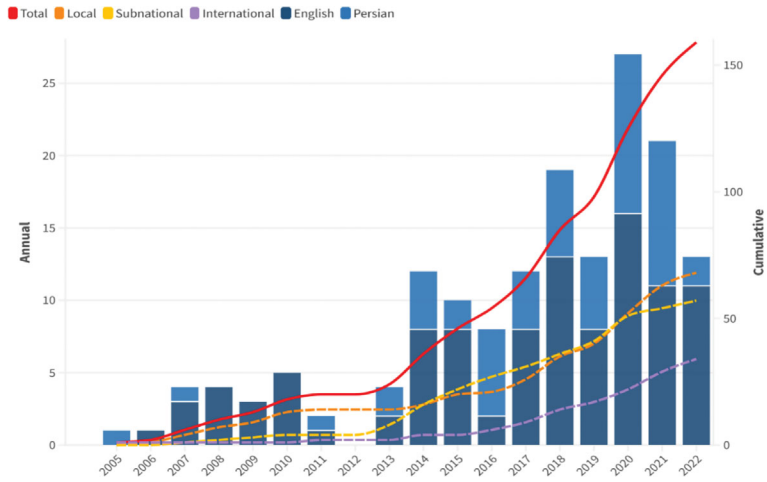

FIGURE 3 The distribution of studies on water conflicts in Iran.

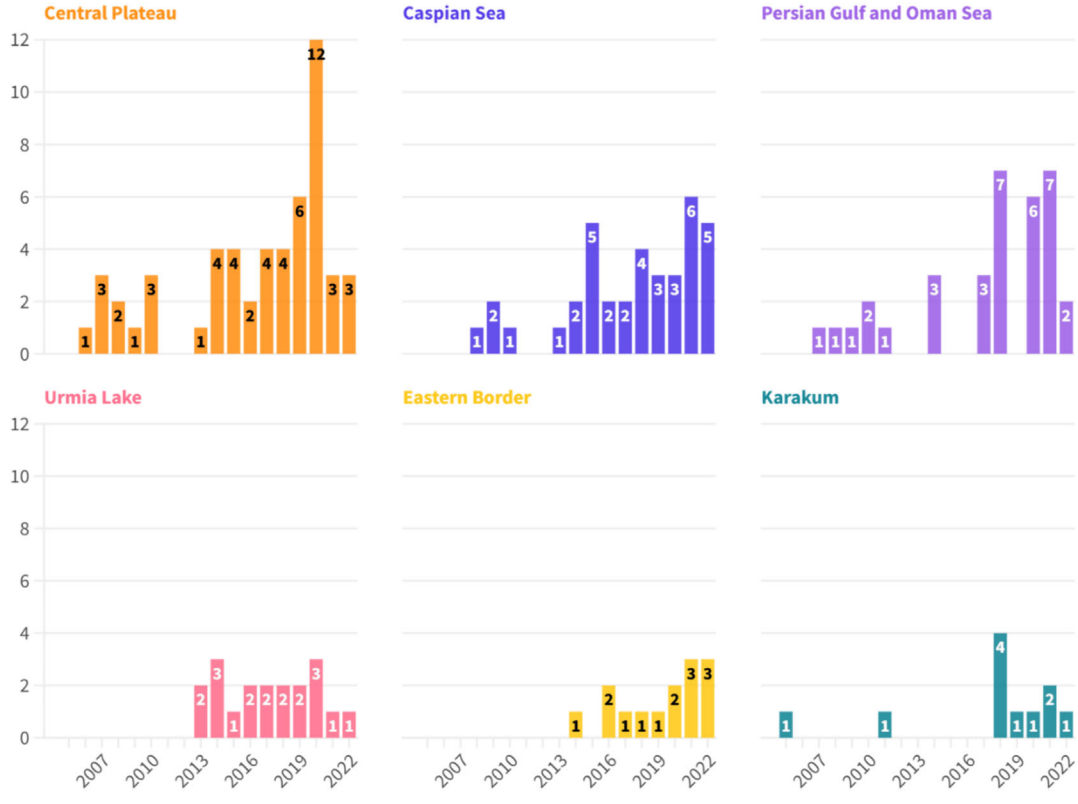

FIGURE 4 The temporal distribution of case studies in the Iran's literature of water conflict.

($n = 36$, 21.43%), with the Sefidrud River capturing 44.44% ($n = 16$) and the Gorgan-Gharesoo River 19.44% (n = 7) of scholarly publications. The Persian Gulf and Oman Sea, covering both subnational and international subbasins, contribute 20.24% ($n = 34$) of scientific publications.

Within this basin, key research focuses include the Karun-e Bozorg ($n = 14$, 41.18%), Karkheh ($n = 11$, 32.35%), and the Western Border rivers ($n = 7$, 20.59%). Lake Urmia, a well-known case, receives scholarly attention with one subbasin comprising 11.31% ($n = 19$) of publications, shaping 89.47% ($n = 17$) of publications on the subnational scale over the basin. In terms of total literature coverage, studies on the Eastern Border ($n = 14$, 8.33%) and Karakum ($n = 11$, 6.55%) water conflicts rank fifth and sixth, respectively, among the main river basins. Table 2 provides data on the scale of water conflict studies within Iran's river basins.

The Eastern Border and Karakum basins are country basin units of the transboundary Helmand and Harirud river basins located in Iran, respectively. These basins are notable areas of focus among international river basins, receiving the majority of scholarly attention.

TABLE 2 The scale of water conflict studies within the main river basins and subbasins of Iran.

	Local		Subnational		International		Total	
	n	%	*n*	%	*n*	%	*n*	%
Central Plateau	32	60.38	21	39.62	0	0.00	53	31.55
Gavkhuni	7	21.88	15	71.43	0	0.00	22	41.51
Namak Lake	12	37.50	2	9.52	0	0.00	14	26.42
Tashk-Bakhtegan	10	31.25	0	0.00	0	0.00	10	18.87
Lut Desert	1	3.13	4	19.05	0	0.00	5	9.43
Siahkouh	1	3.13	0	0.00	0	0.00	1	1.89
Hamoun-e Jazmourian	1	3.13	0	0.00	0	0.00	1	1.89
Caspian Sea	14	37.84	21	56.76	2	5.41	37	22.02
Sefidrud	2	14.29	14	66.67	0	0.00	16	43.24
Gorgan-Gharesoo	6	42.86	1	4.76	0	0.00	7	18.92
Atrak	0	0.00	5	23.81	0	0.00	5	13.51
Talesh-Anzali Lagoon	5	35.71	0	0.00	0	0.00	5	13.51
Aras	1	7.14	0	0.00	2	100.00	3	8.11
Haraz	0	0.00	1	4.76	0	0.00	1	2.70
Persian Gulf and Oman Sea	20	58.82	6	17.65	8	23.53	34	20.24
Karun-e Bozorg	7	35.00	6	100.00	1	12.50	14	41.18
Karkheh	6	30.00	0	0.00	5	62.50	11	32.35
Western Border	5	25.00	0	0.00	2	25.00	7	20.59
Mehran-Kal	1	5.00	0	0.00	0	0.00	1	2.94
Zohre-Jarahi	1	5.00	0	0.00	0	0.00	1	2.94
Lake Urmia	2	10.53	17	89.47	0	0.00	19	11.31
Lake Urmia	2	100.00	17	100.00	0	0.00	19	100.00
Eastern Border	0	0.00	0	0.00	14	100.00	14	8.33
Helmand	0	0.00	0	0.00	14	100.00	14	100.00
Karakum	0	0.00	0	0.00	11	100.00	11	6.55
Harirud	0	0.00	0	0.00	11	100.00	11	100.00
Total	68	40.72	65	38.32	35	20.96	168	100.00

Specifically, out of 35 papers classified as international, 71.43% ($n = 25$) are dedicated to water conflicts in the Helmand and Harirud basins. Despite this, water conflicts within these basins are the least studied among the main river basins thus far, even though they hold significant importance on the international scale. An interesting trend is the increasing scholarly focus on these transboundary water conflicts since the mid-2010s, with 92% of related papers being published during the last decade.[4]

4.3 | Research topics of water conflict literature in Iran

The literature explores various factors driving water conflicts in Iran, with a particular focus on water quantity ($n = 139$, 42.77%), water economics ($n = 66$, 20.31%), and water quality ($n = 44$, 13.54%) as the most prominent topics of study (Figures 5 and 6). Both water quantity and quality have garnered increased attention since the mid-2010s, highlighting a growing concern regarding water scarcity, pollution, and the allocation of water and waste loads as primary drivers of water conflicts in Iran. Notably, economic theories within water conflict studies have seen the highest rate of increase since the late 2000s, which focus on the benefits of sharing water or sharing the benefits of water. Another study topic with consistent attention over time was hydraulic infrastructures ($n = 28$, 8.62%), examining aspects such as dam designing, siting, optimized locating, and operational oversight. Since the mid-2010s, there has been a resurgence in the importance of water governance ($n = 25$, 7.69%), drawing scholarly attention to regulatory frameworks, policy directives, and the complexities arising from divergent interests among stakeholders at multiple levels. A more recent focus in water conflict studies in Iran has been on water and environmental rights ($n = 23$, 7.08%), which have gained increased attention

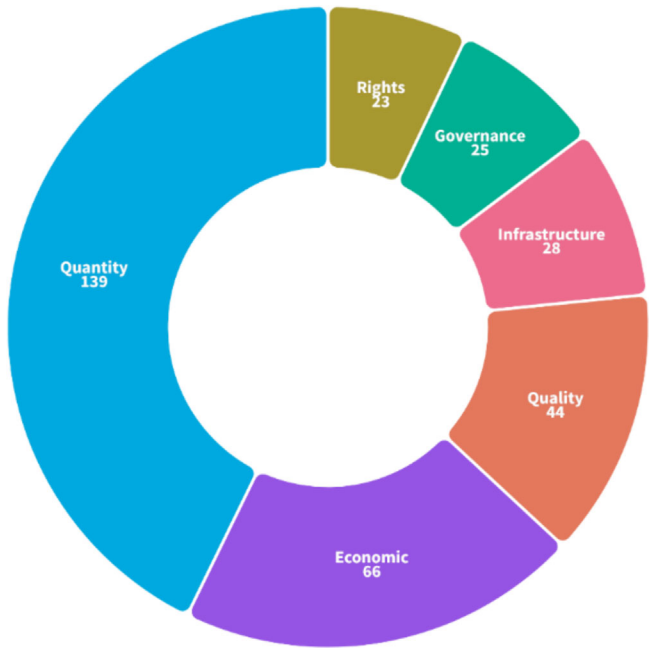

FIGURE 5 Distribution of subjects in water conflict research in Iran.

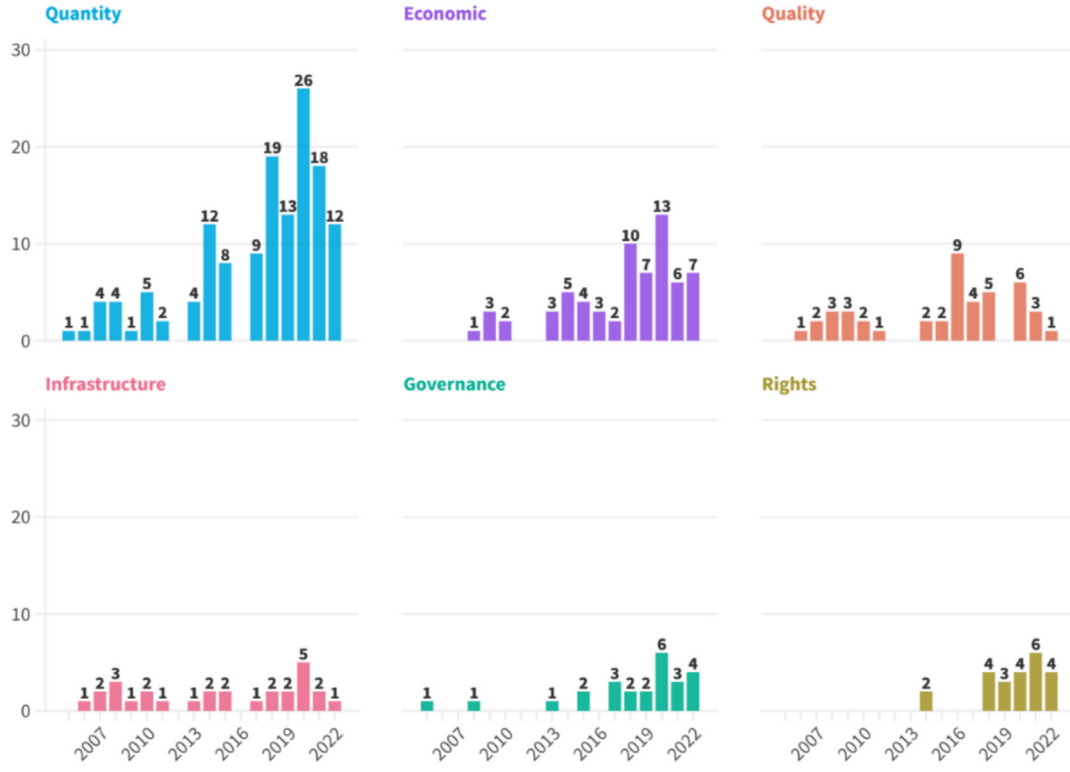

FIGURE 6 Temporal trends in subjects in water conflict research in Iran.

TABLE 3 The scalar extent of water conflict themes addressed in Iranian literature.

	Local		Subnational		International		Total	
	n	%	*n*	%	*n*	%	*n*	%
Quantity	62	41.06	55	49.55	30	43.48	147	44.41
Economics	24	15.89	34	30.63	8	11.59	66	19.94
Quality	28	18.54	8	7.21	0	0.00	36	10.88
Rights	4	2.65	1	0.90	24	34.78	29	8.76
Infrastructure	21	13.91	5	4.50	2	2.90	28	8.46
Governance	12	7.95	8	7.21	5	7.25	25	7.55
Total	151	45.62	111	33.53	69	20.85	331	100.00

since the mid-2010s. These rights, often linked with water allocation provisions in legal and treaty frameworks, are particularly emphasized in transboundary river basins.

Water conflict research topics vary in scale across Iran's river basins, as detailed in Table 3. Water quantity holds roughly equal importance across all scales. Water quality emerges as a major focus in local and subnational contexts, accounting for 81.82% ($n = 36$) of papers, particularly addressing disputes over pollution and waste-load allocation. Water infrastructure is also a significant consideration in local-scale and subnational studies, with 92.86% ($n = 26$) of

papers addressing this aspect. Economic factors also play a crucial role in water conflict analysis, with 87.88% ($n = 58$) of papers exploring economic aspects in local and subnational case studies. Concerns about water rights have become prominent in the Eastern Border and Karakum basins ($n = 20$, 86.96%), both of which Iran is located downstream.

The comparative topical importance of water conflict issues in Iran's main river basins is represented in Figure 7.[5] It shows that, although these are evidenced only by academic literature, each main river basin in Iran has been influenced by a different set of factors shaping water conflicts. Water quantity forms 43.91% ($n = 155$) of the total themes identified in the literature, thereby having indisputable importance across all river basins of Iran. Academic discourses on Lake Urmia, for instance, which has been grappling with aridity over the past two decades, attribute water conflicts to economic drivers in approximately one third of publications ($n = 10$ out of 31). The Central Plateau has garnered 51.85% ($n = 14$) of attention regarding water governance, seemingly due to the protracted and intractable conflicts in the Gavkhuni Basin. In the Persian Gulf and Oman Sea, water quality ($n = 12$, 16.67%) and hydraulic infrastructures ($n = 9$, 12.50%) have emerged as prominent issues. Water rights have been a dominant topic for basins where Iran is located downstream, in the Eastern Border ($n = 13$, 41.94%) and Karakum ($n = 7$, 31.82%). Table 4 provides more details on the relative thematic importance of the main river basins and their subbasins.

4.4 | The prevailing approaches in Iran's water conflict literature

The prevailing approach in the literature of water conflict studies in Iran is conflict resolution. As shown in Figure 8, the reliance on conflict resolution as a dominant approach covering 86.79% ($n = 138$) of scholarly publications is striking, noticeably leaving little room for conflict management ($n = 12$, 7.55%) and conflict transformation ($n = 9$, 5.66%). The distribution of studies adopting water conflict resolution was initially consistent until the early 2010s, experiencing increased attention through the late 2010s, followed by a rapid decline in the early 2020s. Conversely, conflict management has maintained quite steady attention since the early 2010s, while conflict transformation has garnered relatively more weighty concentration since the mid-2010s and the early 2020s in particular.

The prevalence of the water conflict resolution approach reflects a common tendency within scholarly discourse in Iran to view water conflicts as destructive phenomena that, according to conflict resolution theory, require complete eradication or elimination. While conflict resolution has dominated scholarly inquiry for decades, conflict transformation has gained prominence since the late 2010s, and conflict management seems to have garnered the attention. This implies a potential inclination to address water conflicts in alternative ways, diverging from the idea that conflicts should be eliminated by maximizing economic benefits and instead focusing on managing or transforming them. It has consistency with the gradual decrease of publications in water conflict resolution; yet noteworthy is that the "literature" of water conflict analysis in Iran is consistently an advocate for the conflict resolution approach and there is no room for the alternatives.

The adoption of approaches to water conflicts varies across river basins (Figure 9). In most subbasins, the prevailing approach is water conflict resolution, except for the Eastern Border and Karakum basins. These exceptions share a common trait: Iran's downstream position in international river basins. Research papers on these cases emphasize the conflict management approach significantly. While the predominance of water conflict management in these cases

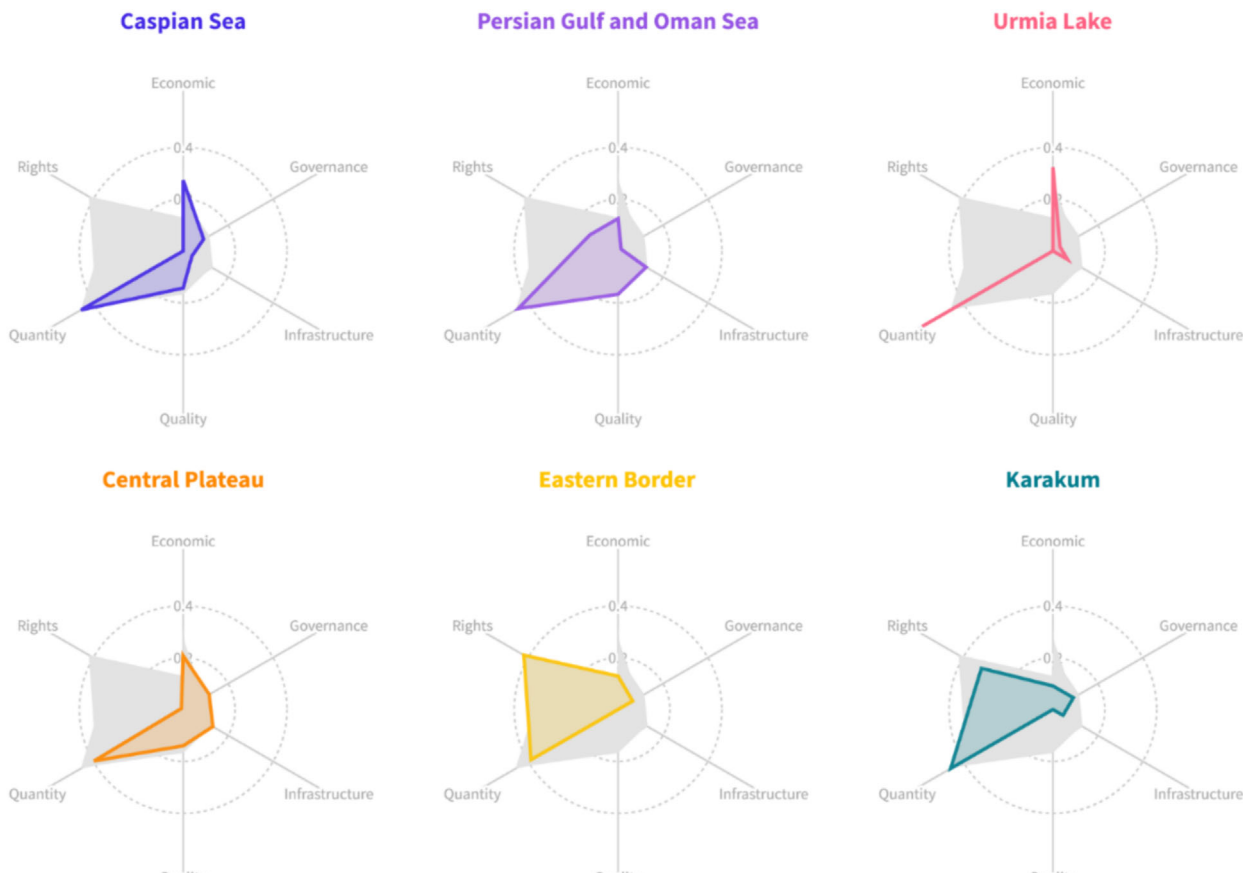

FIGURE 7 The cross-basins comparative importance of themes in water conflict studies in Iran.

TABLE 4 Thematic importance of topics in water conflict studies across river basins in Iran.

	Water quantity		Water economics		Water quality		Water infrastructure		Water rights		Water governance		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Central Plateau	48	39.67	25	20.66	17	14.05	16	13.22	1	0.83	14	11.57	121	100.00
Gavkhuni	20	41.67	13	52.00	2	11.76	5	31.25	1	100.00	6	42.86	47	38.84
Namak Lake	14	29.17	3	12.00	11	64.71	9	56.25	0	0.00	2	14.29	39	32.23
Tashk-Bakhtegan	8	16.67	3	12.00	2	11.76	1	6.25	0	0.00	4	28.57	18	14.88
Lut Desert	4	8.33	4	16.00	2	11.76	1	6.25	0	0.00	1	7.14	12	9.92
H. Jazmourian	1	2.08	1	4.00	0	0.00	0	0.00	0	0.00	1	7.14	3	2.48
Siahkouh	1	2.08	1	4.00	0	0.00	0	0.00	0	0.00	0	0.00	2	1.65
Caspian Sea	35	46.05	20	26.32	11	14.47	3	3.95	0	0.00	7	9.21	76	100.00
Sefidrud	15	42.86	9	45.00	4	36.36	1	33.33	0	0.00	4	57.14	33	43.42
Gorgan-Gharesoo	7	20.00	6	30.00	1	9.09	0	0.00	0	0.00	1	14.29	15	19.74
Talesh-Anzali	4	11.43	3	15.00	5	45.45	0	0.00	0	0.00	0	0.00	12	15.79
Atrak	5	14.29	1	5.00	0	0.00	0	0.00	0	0.00	1	14.29	7	9.21
Aras	3	8.57	1	5.00	0	0.00	1	33.33	0	0.00	0	0.00	5	6.58
Haraz	1	2.86	0	0.00	1	9.09	1	33.33	0	0.00	1	14.29	4	5.26
Persian Gulf and Oman Sea	32	44.44	9	12.50	12	16.67	9	12.50	9	12.50	1	1.39	72	100.00
Karun-e Bozorg	11	34.38	6	66.67	8	66.67	5	55.56	1	11.11	0	0.00	31	43.06
Karkheh	10	31.25	2	22.22	4	33.33	3	33.33	3	33.33	1	100.00	23	31.94
Western Border	8	25.00	1	11.11	0	0.00	0	0.00	5	55.56	0	0.00	14	19.44
Zohre-Jarahi	2	6.25	0	0.00	0	0.00	1	11.11	0	0.00	0	0.00	3	4.17

(Continues)

TABLE 4 (Continued)

	Water quantity		Water economics		Water quality		Water infrastructure		Water rights		Water governance		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Mehran-Kal	1	3.13	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	1.39
Lake Urmia	18	58.06	10	32.26	0	0.00	2	6.45	0	0.00	1	3.23	31	100.00
Lake Urmia	18	100.00	10	100.00	0	0.00	2	100.00	0	0.00	1	100.00	31	100.00
Eastern Border	12	38.71	4	12.90	0	0.00	0	0.00	13	41.94	2	6.45	31	100.00
Helmand	12	100.00	4	100.00	0	0.00	0	0.00	13	100.00	2	100.00	31	100.00
Karakum	10	45.45	2	9.09	0	0.00	1	4.55	7	31.82	2	9.09	22	100.00
Harirud	10	100.00	2	100.00	0	0.00	1	100.00	7	100.00	2	100.00	22	100.00
Total	155	43.91	70	19.83	40	11.33	31	8.78	30	8.50	27	7.65	353	100.00

FIGURE 8 The temporal distribution of approaches in Iran's literature on water conflict.

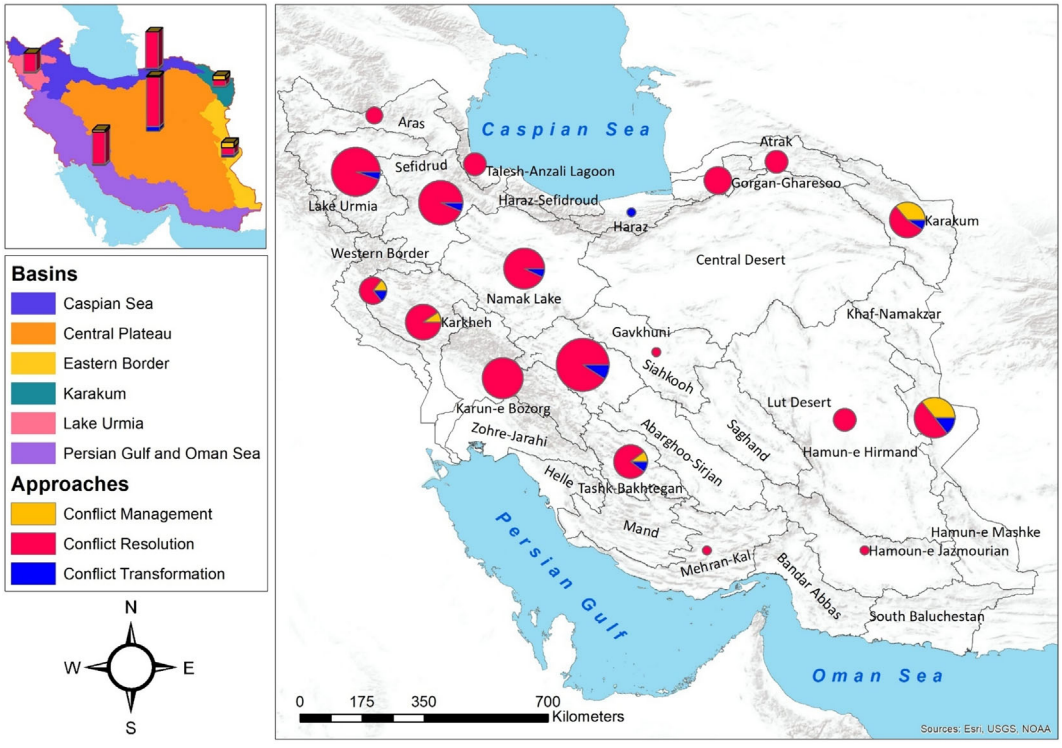

FIGURE 9 Distribution of approaches taken to water conflict analysis in the Iran's literature across the river basins.

may be attributed to their international-scale water conflicts, caution is needed; the limited adoption of conflict management and remaining conflict resolution in western Iran, where Iran is upstream in the transboundary Tigris River, is notable. The disparity in enthusiasm for conflict management between western and eastern boundaries arises from their distinct contexts. In the west, Iran's upstream position allows for greater control over hydraulic infrastructures and access to water resources. In contrast, eastern and northeastern Iran suffer adverse effects

from upstream hydraulic mission. The conflict management approach challenges the legitimacy of these upstream hydraulic missions within legal frameworks, while conflict resolution is preferred when Iran is upstream, aiming to optimize equitable and reasonable water utilization. Additionally, the severe conflict-driven consequences in eastern Iran may explain the greater scientific attention in this region, where sociopolitical and environmental impacts are more pronounced than in the west.

The approaches to water conflict analysis in Iran's literature consider different research topics and identify various drivers of water conflicts (Figure 10). Water quantity is the predominant issue across all approaches, accounting for 45.17% ($n = 131$) in conflict resolution, 42.86% ($n = 9$) in conflict management, and 41.18% ($n = 7$) in conflict transformation. Conversely, hydraulic infrastructures are consistently considered in less than 10% of the studies across all approaches. These trends underscore the critical importance of water access, allocation, and distribution through hydraulic infrastructures. Water economics significantly influences water conflict resolution, making up 22.41% ($n = 65$ out of 290) of research using this approach. In contrast, its presence diminishes notably in conflict transformation, with only 5.88% ($n = 1$), and is entirely absent in conflict management. Similarly, water quality is primarily considered in water conflict resolution, shaping 12.07% ($n = 35$) of papers using this approach, while it is less prominent in conflict management and contributes only 5.88% ($n = 1$) to conflict transformation. Conflict-generating structures within water governance are represented in 41.18% ($n = 7$) of studies using the conflict transformation approach, contrasting sharply with their absence in conflict management and a modest 6.21% ($n = 18$) in water conflict resolution. Similarly, water rights issues are significantly addressed in 52.38% ($n = 11$) of conflict management studies, compared to 5.17% ($n = 15$) in water conflict resolution and none in conflict transformation.

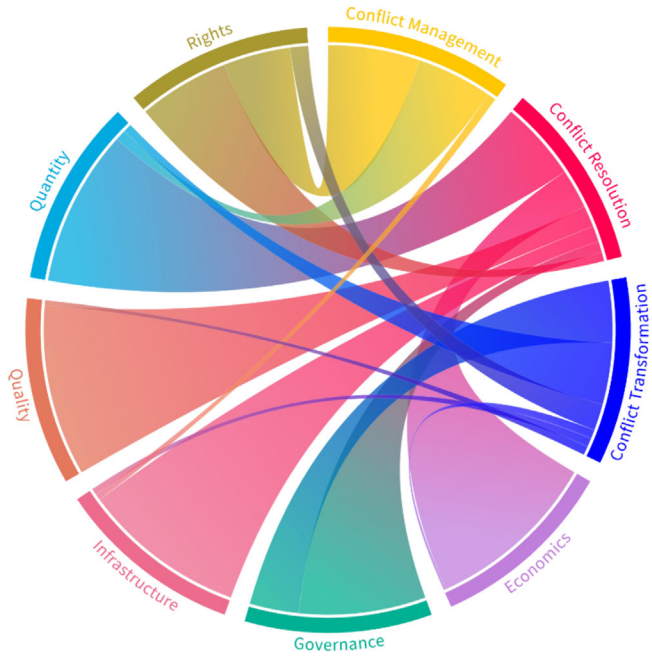

FIGURE 10 The relationships between approaches and subjects of water conflict studies in Iran.

This uneven distribution implies that, aside from the predominant focus on water quantity, the analytical emphasis varies significantly across different approaches, influencing their effectiveness at various application scales. In the scholarly literature on water conflicts in Iran, conflict management predominantly emphasizes predefined water rights, overlooking numerous other influential factors. Notably, 91.67% ($n = 11$) of conflict management studies focus on water rights at the international scale, limiting their relevance in local and subnational contexts. Conversely, conflict resolution largely centers on the use of numerical models with a strong emphasis on economic functionalities. This approach is applied in 45.65% ($n = 63$) of local-scale and 39.86% ($n = 55$) of subnational water conflicts, with only 14.49% (n = 20) of studies exploring transboundary river basins. In contrast, conflict transformation presents a more holistic approach by integrating water governance with other topics. This inclusive approach demonstrates versatility across scales, with 44.44% ($n = 4$) of studies at the local level, 33.33% ($n = 3$) at the international level, and 22.22% ($n = 2$) at the subnational level.

4.5 | Commonly used models for water conflict analysis in Iran

Water conflict studies in Iran have employed various models and analytical frameworks, as shown in Figure 11. Game theory has emerged as the predominant analytical tool, making up 32.89% ($n = 124$) of the total models used. Within this category, both noncooperative game theory ($n = 60$, 48.39%) and cooperative game theory ($n = 59$, 47.58%) are notably prevalent, with similar levels of use. Optimization represents a significant techno-engineering algorithm for

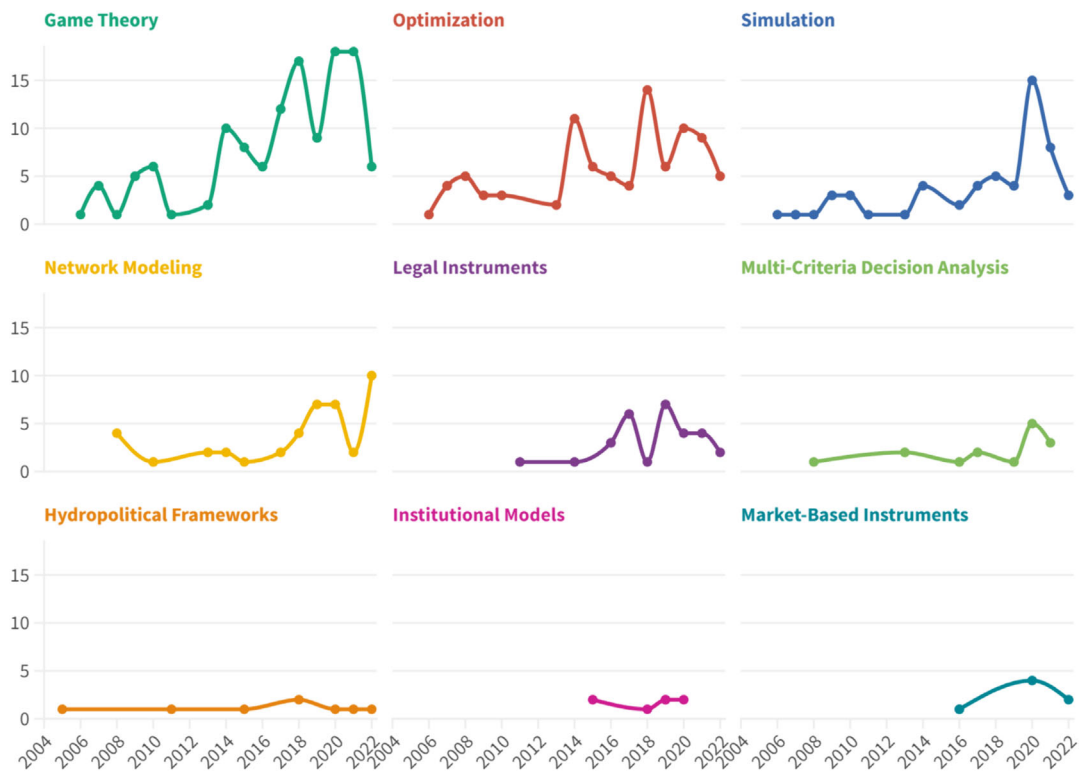

FIGURE 11 Temporal distribution of model utilization in water conflict studies in Iran.

TABLE 5 Models and mechanisms used in Iran's literature for water conflict analysis across basins.

	Central Plateau		Persian Gulf and Oman Sea		Caspian Sea		Lake Urmia		Eastern Border		Karakum		Total	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Game theory	42	31.58	36	27.07	27	20.30	19	14.29	4	3.01	5	3.76	133	33.08
Optimization	40	42.11	17	17.89	26	27.37	9	9.47	1	1.05	2	2.11	95	23.63
Simulation	29	49.15	15	25.42	8	13.56	3	5.08	3	5.08	1	1.69	59	14.68
Network modeling	25	54.35	7	15.22	7	15.22	5	10.87	1	2.17	1	2.17	46	11.44
Legal instruments	1	3.45	5	17.24	1	3.45	1	3.45	14	48.28	7	24.14	29	7.21
MCDA	3	18.75	8	50.00	3	18.75	2	12.50	0	0.00	0	0.00	16	3.98
Hydropolitical frameworks	1	11.11	0	0.00	0	0.00	1	11.11	3	33.33	4	44.44	9	2.24
Institutional models	4	50.00	0	0.00	0	0.00	0	0.00	3	37.50	1	12.50	8	1.99
Market-based instruments	5	71.43	0	0.00	0	0.00	1	14.29	1	14.29	0	0.00	7	1.74
Total	150	37.31	88	21.89	72	17.91	41	10.20	30	7.46	21	5.22	402	100.00

addressing water conflicts, constituting the second most employed model at 23.87% ($n = 90$) of the models used in the literature. Multi-objective optimization is the most common method within this category, accounting for 64.44% ($n = 58$) of the algorithms, followed by stochastic programming ($n = 12$, 13.33%), nonlinear programming ($n = 12$, 13.33%), and linear programming ($n = 7$, 7.78%). Simulation is the third most utilized model, with a 14.59% ($n = 55$) representation in water conflict studies in Iran. It is primarily implemented through finite difference modeling ($n = 35$, 63.63%), which evaluates water system behaviors such as flow, contamination transport, and water quality. This technique is often integrated with optimization strategies or game theory but is also used as an independent model through system dynamics ($n = 12$, 21.82%).

Network modeling, another complementary technique, constitutes 11.14% ($n = 42$) of the water conflict literature in Iran. Hydrological network analysis occupies a prominent position within this category ($n = 19$, 45.24%), focusing on delineating physical connections and interdependencies among water bodies. It employs numerical modeling to elucidate the impacts of hydrological processes on water quantity and quality dynamics. Social network analysis ($n = 14$, 33.33%) maps and models social interactions and relationships within the context of water conflicts, while economic network analysis ($n = 8$, 19.05%) examines economic interactions among users, producers, consumers, and various stakeholders, focusing on identifying incentives and constraints influencing water resources allocation and distribution. Multi-Criteria Decision Analysis (MCDA) is another complementary model, used in 3.98% ($n = 15$) of studies to evaluate, rank, and weigh management options and criteria relationships. Legal instruments are the focus of 7.69% ($n = 29$) of water conflict research, providing solutions and ranking as the fifth most utilized model. These legal instruments are applied in 93.10% ($n = 27$) of international-scale water conflict studies. Consequently, the essence of water conflict analysis within the conflict management approach predominantly revolves around legal regime analysis, focusing on water rights and allocation ($n = 10$, 34.48%), legal and institutional analysis ($n = 9$, 31.03%), and environmental law ($n = 6$, 23.08%).

Hydropolitical frameworks are the seventh most frequently employed models in the water conflict discourse of Iran ($n = 8$, 2.12%). Some research endeavors integrate both legal instruments and hydropolitical frameworks when investigating transboundary water conflicts. However, the prevalence of legal regime analysis suggests a tendency to view transboundary water conflicts through a legal lens, potentially neglecting the broader impacts of transboundary water politics, societal influences on foreign water policies, and the enduring repercussions of geopolitical dynamics that shape hydropolitical interactions. The increasing focus on legal instruments can be partly attributed to the growing body of literature addressing transboundary water conflicts in the Helmand and Harirud river basins. Table 5 provides detailed information on the utilization of models and mechanisms across the main river basins for water conflict analysis in Iran.

The models employed in water conflict research in Iran are based on various approaches. While some models adhere to specific approaches, others offer versatility (Figure 12). Game theory frameworks, optimization–simulation techniques, MCDA, and market-based instruments are tailored to conflict resolution. In contrast, frameworks such as network modeling demonstrate adaptability across different approaches. For instance, conflict resolution employs hydrological network analyses, while conflict transformation emphasizes social and multilevel network analyses. Legal instruments are commonly used within conflict management; however, when applied to conflict resolution, they focus on enhancing water allocation optimality within the framework of stipulated water and environmental rights. Hydropolitical frameworks,

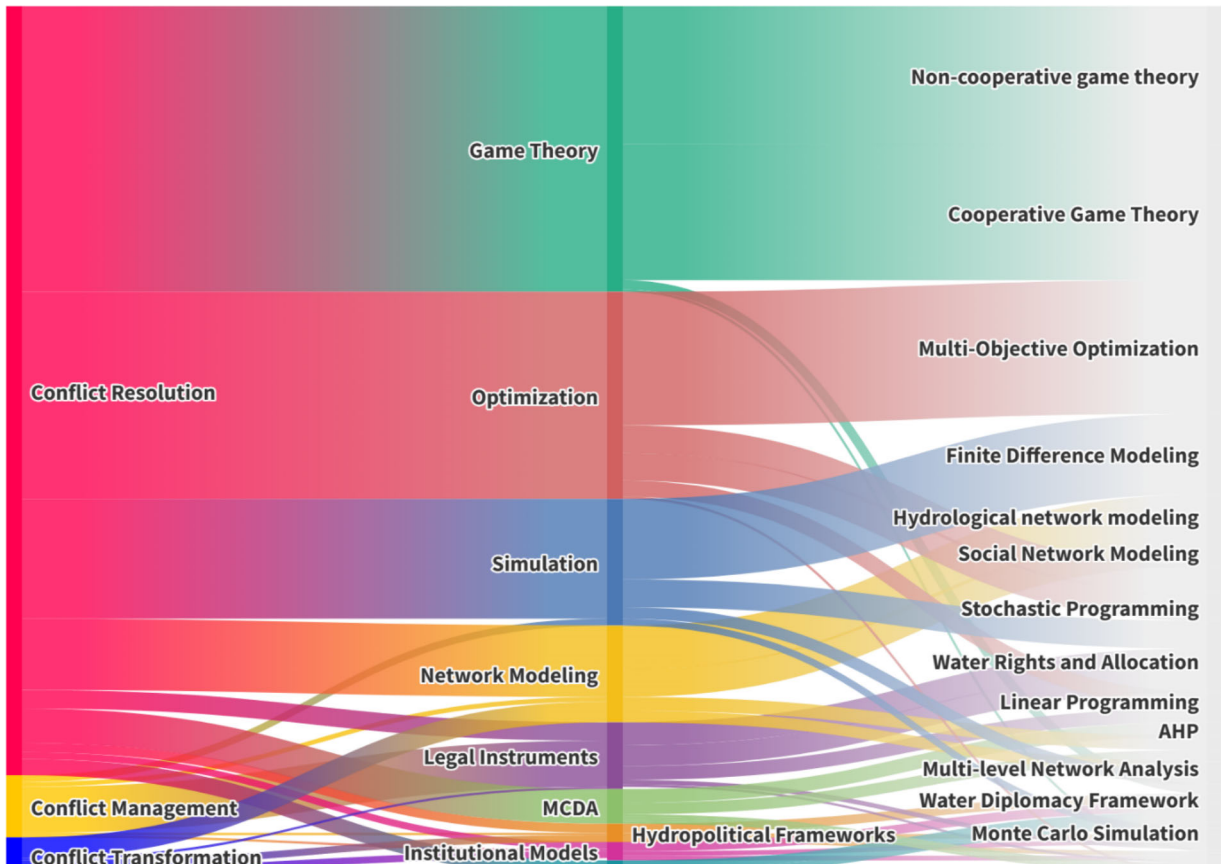

FIGURE 12 The diagram of water conflict analysis approaches, models, and variations in Iran.

particularly in the context of the water–energy–food nexus, are tools for deciphering hydropolitical vulnerabilities to achieve effective conflict resolution. These frameworks address challenges in hydropolitics and water diplomacy numerically. In contrast, hydropolitical frameworks in conflict transformation explore the transboundary water interaction nexus,

TABLE 6 Cross-tabulation of approaches in Iran's literature of water conflict with examined variables.

	Conflict management		Conflict resolution		Conflict transformation		Total	
	n	%	*n*	%	*n*	%	*n*	%
Publication language	12	7.55	138	86.79	9	5.66	159	100.00
English	5	41.67	91	65.94	7	77.78	104	65.41
Persian	7	58.33	47	34.06	2	22.22	55	34.59
Scale	12	7.55	138	86.79	9	5.66	159	100.00
Local	1	8.33	63	45.65	4	44.45	68	42.77
Subnational	0	0.00	55	39.86	2	22.22	57	35.85
International	11	91.67	20	14.49	3	33.33	34	21.38
Topic	21	6.40	290	88.42	17	5.18	328	100.00
Quantity	9	42.86	131	45.17	7	41.18	147	44.82
Economics	0	0.00	65	22.41	1	5.88	66	20.12
Quality	0	0.00	35	12.07	1	5.88	36	10.97
Infrastructure	1	4.76	26	8.97	1	5.88	28	8.54
Rights	11	52.38	15	5.17	0	0.00	26	7.93
Governance	0	0.00	18	6.21	7	41.18	25	7.62
Main river basin	12	7.14	145	86.31	11	6.55	168	100.00
Central Plateau	1	1.89	48	90.57	4	7.55	53	31.55
Caspian Sea	0	0.00	35	94.59	2	5.41	37	22.02
Persian Gulf and Oman Sea	2	5.88	31	91.18	1	2.94	34	20.24
Lake Urmia	0	0.00	18	94.74	1	5.26	19	11.31
Eastern Border	5	35.71	7	50.00	2	14.29	14	8.33
Karakum	4	36.36	6	54.55	1	9.09	11	6.55
Model	27	11.69	188	81.38	16	6.93	231	100.00
Game theory	0	0.00	77	40.96	0	0.00	77	33.33
Optimization	0	0.00	53	28.19	0	0.00	53	22.94
Simulation	3	11.11	26	13.83	0	0.00	29	12.55
Network modeling	2	7.42	15	7.98	9	56.25	26	11.26
Legal instruments	20	74.07	3	1.59	1	6.25	24	10.39
MCDA	0	0.00	7	3.72	0	0.00	7	3.03
Hydropolitical frameworks	1	3.70	4	2.13	3	18.75	8	3.47
Institutional models	1	3.70	2	1.06	3	18.75	6	2.60
Market-based instruments	0	0.00	1	0.53	0	0.00	1	0.43

providing contextual insights by examining the coexistence of conflicts and cooperation in the historical context of relations.

Ultimately, we can discern associations between the approaches and the examined variables in Iran's literature on water conflict analysis. Table 6 illustrates the extracted data of the present research. Conflict management is predominantly employed at the international scale, while conflict resolution is utilized at the local and subnational scales. Conflict transformation, on the other hand, exhibits versatility and is adopted across various scales. Conflict management focuses primarily on international and customary law, whereas conflict resolution emphasizes economic factors. Conflict transformation encompasses a broader range of topics, commonly integrating them with water governance issues. Traces of application of conflict transformation are present in all main river basins; however, conflict management is primarily applied in basins with international characteristics, such as the Eastern Border and Karakum, while conflict resolution is prevalent in the subnational scale. Regarding models, conflict management predominantly utilizes legal instruments. Game theory and optimization techniques constitute the primary tools for conflict resolution, while network modeling serves as the basis for conflict transformation.

5 | DISCUSSION

This paper advocates for a systematic comprehension of approaches to grasp prevailing attitudes and mindsets toward water conflicts from an analytical viewpoint. The research findings highlight that, although all three approaches are utilized, the predominant scholarly discourse in Iran's water conflict analysis literature leans toward and reproduces the water conflict resolution approach along with its associated models and mechanisms. This section elaborates on the limitations of this dominant discourse, particularly emphasizing the deficiencies of water conflict resolution models and mechanisms. It also delves into the growing interest in water conflict transformation as the emphasis on conflict resolution wanes.

5.1 | The incontinency and dissension in water conflict analysis

The findings indicate a wide array of models and mechanisms used in dealing with water conflicts in Iran. For instance, both cooperative and noncooperative variations of game theory are applied with similar frequency. This duality is noteworthy as these variations embody distinct ontological assumptions: noncooperative game theory posits that decision-makers prioritize self-interest, aiming to maximize individual gains irrespective of their impact on others. In contrast, cooperative game theory suggests that decision-makers seek mutual benefits, guiding their choices toward options that maximize collective gains (Madani, 2010). The prevalence of both game-theoretical frameworks suggests a lack of consensus among scholars regarding the underlying behavioral motives of decision-makers in these contexts (Momenpour et al., 2021), underscoring an ongoing debate between actions driven by mutual benefits vis-à-vis self-interests.

This issue becomes more problematic when a significant number of studies utilize optimization algorithms to address water conflicts, often overlooking the alignment of their ontological stances with the contextual realities. Optimization algorithms are frequently employed to tackle multiple objectives like water allocation and river–reservoir operations in resolving water conflicts among stakeholders. These models aim to find the optimal compromise solution by

employing strategies of maximization/minimization or Pareto optimality to balance and derive solutions based on this equilibrium (Loucks & van Beek, 2017). The fundamental assumption is that decision-makers exhibit inherent rationality and cooperate once an equilibrium is reached (Tayia, 2019). However, this assumption contradicts the foundational principles of noncooperative game theory, which entertains the possibility that decision-makers may prioritize self-interest, potentially at the expense of other stakeholders. This incongruity underscores the need for a careful examination of the ontological foundations of models and mechanisms (i.e., the approaches) and their appropriateness for the specific context of water conflict analysis.

We further argue the mismatch between the context and commonly utilized models in Iran's water conflict analysis literature. The outcomes of this study highlight a prevailing inclination toward techno-economic analyses of water conflicts, with a corresponding emphasis on proposing technical solutions to these challenges. This is while, in a broader sense, water problems and issues encompass a wider array of dimensions, including techno-economic, managerial, and societal aspects (Fasihi Harandi et al., 2014). While Iran's literature often prioritizes technical issues using tools like game theory and optimization–simulation models, water conflicts in Iran are characterized by complex managerial, societal, identity, and normative challenges. Expanding on this systematic mismatch, we contend that models and mechanisms are frequently applied irrespective of the real issues at hand, potentially contributing to the ineffective dealing with water conflicts.

5.2 | Dispairs in dominancy of water conflict resolution

It is important to note that, despite the various types of techno-economic models used in Iran's literature on water conflict analysis, the results demonstrate that they predominantly reflect the water conflict resolution approach. This prevalence of conflict resolution reflects a tendency within Iran's scholarly discourse to regard water conflicts as phenomena that warrant complete eradication or elimination. However, this prevailing mindset stems from a misunderstanding of the nature and contributing factors of water conflicts in Iran. Contrary to this common misconception, water conflicts should not be inherently approached as irreversibly destructive predicaments necessitating eradication; rather, conflicts can be restructured into constructive relationships (Lederach, 2003; Robbins, 1978). The prevalence of water conflict resolution in Iran partially falls short in considering these constructive perspectives, relying heavily on numerical modeling and the establishment of multiple objectives, thereby engaging in processes of maximization or minimization.

The results of this paper, which indicate the dominance of the conflict resolution approach in Iran, reveal a narrow scope in addressing the extent of influential factors and addressing root causes in water conflict analysis. Consequently, these studies often engage in analytical reductionism, encounter problems in policymaking, make strategic errors in defining initiatives, and face implementation barriers when putting solutions into practice. Water conflict resolution approaches often lack a holistic exploration of contextual factors such as identities, norms, and values, instead prioritizing a narrow focus on cost–benefit analysis and a pro-peace-security orientation (Nagheeby & Amezaga, 2023). It underscores the imperative for water scholarly pursuits to engage in comprehensive examinations of the root causes through "why-chained" questions in response to specific issues (see Sehring & Wolf, 2023). This paradigm shift in scholarly discourse would facilitate a comprehensive analysis that extends beyond superficial

occurrences to uncover the structures and attitudes that contribute to conflict relations (Dugan, 1996; Galtung, 1996; Lederach, 2005; Wallensteen, 1991).

The essence of this discussion lies in the need for water conflict studies in Iran to adopt the water conflict transformation approach, recognizing that the surface issue often masks deeper complexities and represents a mere manifestation of concealing deeper complexities. It thereby necessitates a thorough exploration of the complex web of water conflicts within the unique contexts of river basins. It implies that the importance of models and mechanisms in water conflict analysis lies not in their technical differences, but in their overarching mindsets and approaches; which in Iran's water conflict analysis literature is commonly aligned with the water conflict resolution approach. This approach, however, inherently struggles to address the full complexity of water conflicts, as the main issues are not merely techno-economic. The Iranian academic discourse on water conflict analysis therefore requires a broader scope and moving beyond the simplistic goal of eradication toward a more comprehensive and inclusive approach that encompasses the complexities of conflicts—*water conflict transformation*.

5.3 | From resolution to transformation: A hope for an approach shift?

This discussion emphasizes, at least from an analytical perspective, the need for water conflict studies in Iran to adopt the water conflict transformation approach; however, the adoption of water conflict transformation can be traced in basins like Gavkhuni, Helmand, Lake Urmia, and Namak Lake basins. We argue that within these basins, where water conflict transformation is adopted, water conflicts have been exacerbated as the government loses its role as a mediator in conflict resolution. In other words, policy instruments increasingly be unsuccessful in mitigating water conflicts, as well as inadequate compliance between gesellschaft and governance structure with the solutions proposed. This indicates that water conflicts within these basins—and potentially others—are not merely seen as economic, water quantity, or infrastructural issues typically focused on in conflict resolution. Instead, the emergence of water conflict transformation results from scholarly attention shifting from merely focusing on the material factors toward contextualizing the role of these non-material factors in perpetuating and worsening water conflicts; albeit not yet constituting the research mainstream.

The lack of success in addressing water conflicts can be examined from various perspectives. This paper sheds light on a part of this inadequacy that is attributed to the failure to adopt an appropriate approach in research. In light of these, the results of this paper demonstrate that water conflict analysis in Iran's literature commonly reproduces the conflict resolution's mindset, proving the theoretical and practical deficits in dealing effectively and constructively with water conflicts. Foremost in dealing effectively with water conflicts is the comprehensive analysis; thus, the approach shift is imperative to adopt water conflict transformation more frequently in research, since this approach is preferred in peace and conflict studies (Galtung, 1996; Galtung & Fischer, 2013; Lederach, 2003; Lloyd, 2001; Parlevliet, 2009; Reimer et al., 2015; Richmond, 2002; Ropers, 2004; Wallensteen, 1991), and particularly in water conflict research (Mamasani et al., 2024; Nagheeby & Amezaga, 2023; Sehring & Wolf, 2023; Wolf, 2012; Zeitoun et al., 2014, 2020). The more adoption of the water conflict transformation at the outset of dealing with water conflicts, the conflict analysis, the more effective solutions to water conflict will potentially be.

6 | CONCLUSION

This paper presents a comprehensive analysis of the academic literature on water conflict analysis in Iran, focusing on the prevalent multi-scalar water conflicts that are emerging and exacerbating. Through a systematic review method, we selected 159 peer-reviewed papers from a pool of 2799 to identify recurring patterns, trends, and analytical approaches to water conflicts. The findings reveal a significant surge in research on Iran's water conflicts since the mid-2010s, predominantly adopting the water conflict resolution approach. Consequently, analytical models associated with this approach, such as game theory and optimization, were extensively employed. These studies mainly delve into the economic ramifications of water in conflict scenarios. In contrast to the dominance of the water conflict resolution approach, water conflict management and water conflict transformation approaches remain underrepresented in Iran's water conflict analysis literature.

The findings prompt us to address the incongruity between the conflict resolution approach and the conventional analytical models employed in Iran's literature on water conflict analysis. We contend that the application of these models within the conflict resolution framework is incongruous with the inherent nature of water conflicts in Iran. While many of researches focus on techno-economical aspects, water conflicts in Iran also encompass managerial, social, and normative dimensions that are not adequately captured in the literature, and their ontological stance misses the alignment with the complexities of water conflicts. Thus, the present paper advocates for challenging the dominance of the water conflict resolution approach in the literature and shifting toward the water conflict transformation approach. This shift would enable the recognition and elucidation of the role of non-material factors in conflict analysis. Such a necessity is evident in studies that have adopted the conflict transformation approach, but the prevailing approach remains conflict resolution, which allows root causes to remain, to a certain extent, misidentified.

Water conflicts in Iran often exhibit an exponential trajectory, characterized by the continuous emergence of challenges that intertwine with existing issues, rendering conflict resolution efforts largely ineffective. This paper sought to elucidate these failures from the perspective of the approaches adopted in conflict analysis. However, a comprehensive investigation into the causes of Iran's inability to effectively address water conflicts, spanning local to international scales, requires complementary research in the field of implementation. It is anticipated that, just as the techno-economic perspective dominates the analysis of water conflicts in the literature, the implementation phase will likely adhere to a similar conflict resolution approach, thereby neglecting opportunities for transformation or rendering water conflicts manageable. Future research endeavors could systematically analyze the implementation phase of water conflict management in Iran, or potentially through case studies, to test the proposed hypothesis. Additionally, future studies can expand upon the suggestions presented in this paper for researchers and provide policy recommendations to facilitate a shift from resolution toward transformation.

Furthermore, this paper established a framework for a systematic review of dominant approaches in the literature on water conflicts, implemented it in Iran's water conflicts analysis literature, and presented its findings. However, the applicability of this framework extends beyond Iran. It can be employed to examine dominant approaches at the river basin level (e.g., Nile, Jordan, Helmand) or at the regional level (e.g., West Asia, Central Europe, South America). Systematic reviews of individual basins can elucidate the prevailing approaches in different contexts and assess their impact on cooperative outcomes. Comparative analyses

between river basins, countries, and regions are also feasible. For instance, comparisons could be drawn between the Helmand River and the Scheldt-Meuse, Iran and the Netherlands, or the Middle East and Europe from the perspective of approaches to water conflict analysis and their practical implications. Such a future research direction can challenge the dominance of inappropriate approaches, as each region offers lessons that can inform researchers, managers, and policymakers.

AUTHOR CONTRIBUTIONS

Milad Jafari: Conceptualization; formal analysis; investigation; resources; data curation; visualization; writing—original draft; methodology; writing—review and editing; project administration. **Behnam Andik:** Formal analysis; visualization; writing—review and editing. **Hojjat Mianabadi:** Conceptualization; formal analysis; validation; resources; writing—review and editing; supervision. **Amineh Ghorbani:** Validation; writing—review and editing. **Sedigheh Nasri Fakhredavood:** Funding acquisition; writing—review and editing. **Shahla Choobchian:** Validation; writing—review and editing. **Seyedeh Simin Mirhashemi Dehkordi:** Writing—review and editing.

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CONFLICT OF INTEREST STATEMENT

No competing interest to declare.

DATA AVAILABILITY STATEMENT

The data are available as a supplementary resource.

ETHICS STATEMENT

Center for International Scientific Studies and Collaboration (CISSC) ethical committee approved the research. Authors confirm that all research was performed following relevant guidelines/regulations. Also, this research has been performed under the Declaration of Helsinki. The authors confirm that informed consent was obtained from all participants and/or their legal guardians. The informed consent was written in language easily understood by participants and they had sufficient time to consider participation.

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ENDNOTES

[1] The focus of this paper, among the multiple sets of approaches to conflicts that have been developed and implemented, is on the dominant ones. Conflict settlement and prevention, for example, in addition to the dominant approaches of conflict management, resolution, and transformation, are among the approaches that are used in real-world practices.

[2] Variables for identifying approaches to water conflict extend beyond their objectives and strategies. Each approach embodies a distinct paradigm, resulting in divergent principles and foundations ranging from philosophy and anthropology to their respective practical applications. Nonetheless, the present study has exclusively relied on these variables, as data extraction based on others necessitates metatextual analysis and an understanding of the author's or research team's mindset. While this method of acquisition understanding is of significant value, it was deemed unnecessary due to the potential for ambiguity and the fact that papers do not invariably commence from such a theoretical foundation and, therefore, may not possess ontological or epistemological stances. Given the substantial differences in the objectives and strategies of conflict management, resolution, and transformation, these two variables alone were employed as the analytical framework in this paper.

[3] It is essential to clarify that, despite the absence of publications in 2012, this paper dismisses arguments suggesting a lack of scientific output within Iran's water conflict literature during that year. It is plausible that papers exist that do not explicitly declare their focus on water conflict analysis or may have been excluded during the data collection process due to ineligibility under the present research criteria. However, the overall publication trend of the included papers corroborates that the provided overview accurately reflects the trajectory of water conflict studies in Iran.

[4] There has been an increasing scholarly focus and publications on the Helmand and Harirud water conflicts from the mid-2010s to the early 2020s, while water conflicts between Iran and Afghanistan date back to the 19th century. The reasons for this trajectory in water conflict analysis need further investigation to demonstrate the factors influencing Iranian scholarly attention to dedicated Iran–Afghanistan water conflicts.

[5] To avoid the influence of raw data on the visualization of research topic importance, the frequency of each topic within a given river basin was normalized by dividing it by the total number of coded topics within all river basins in Iran. The resulting values were then plotted on diagrams. The gray background of the diagrams represents the total coverage of topics across all river basins in Iran. The colored shapes represent the varying degrees of attention given to different topics within the literature on river basins.

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