

Four Decades of Conflict and Water Governance in Iraq: A Literature Review of the Structural Impacts of Successive Wars (1980–2020)

Haider H. Al-Tameemi¹, Maha R. Alzaidi² & Ahmad J. Ibrahim³

¹ Ministry of Water Resources, Baghdad, Iraq

^{2,3} Department of civil engineering techniques, University of Dijlah, Baghdad, Iraq

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ABSTRACT

This paper analyses the structural impacts of armed conflicts on Iraq's water resources sector from 1980 to 2020, covering wars (Iraq-Iran War, Gulf War, Post-2003 period, and ISIS). Based on a multidisciplinary literature review, the study identifies four main pathways through which conflicts have shaped the sector's operational environment: (1) physical damage to infrastructure; (2) constraints on long-term planning; (3) disruptions of hydrological time-series data; and erosion of human capacities and institutional memory. These cumulative effects cannot be understood in isolation from the broader context of instability. Comparisons with Syria, Yemen, and Afghanistan reveal a common international pattern where institutional recovery lags behind infrastructure rehabilitation. The paper concludes that armed conflicts have cumulatively and structurally affected Iraq's water sector, and sustainable recovery requires integrated approaches that simultaneously address technical, institutional, and human dimensions.

Corresponding Author:

HAIDER H. AL-TAMEEMI

First Senior Chief Engineer, Ministry of Water Resources

Baghdad, Iraq

Email: Abumasara19731973@gmail.com

1. INTRODUCTION

The water resources sector is one of the sectors most closely linked to long-term stability in countries dependent on agriculture and transboundary rivers, as is the case in Iraq. Water management requires operational continuity, long-term planning, and accumulated knowledge that is difficult to maintain in environments characterized by instability. Since the early 1980s, Iraq has experienced a series of armed conflicts, interspersed with varying periods of reconstruction, which has contributed to creating a complex operational environment for service sectors. International literature indicates that conflicts not only lead to the direct destruction of infrastructure but also leave cumulative effects that extend for many years after the cessation of military operations [1].

This review covers the period from 1980 to 2020, a timeframe chosen because it encompasses four complete decades of successive conflicts (the Iran-Iraq War 1980-1988, the 1991 Gulf War, the post-2003 period, and the conflict with ISIS 2014-2017), allowing for an analysis of their cumulative effects. This study focuses on analyzing the structural and contextual impacts of armed conflicts on Iraq's water resources sector, based on a review of available literature, with the aim of placing these impacts within a broader analytical framework that takes into account national specificities and the regional context. Despite the growing body of literature on Iraq's water challenges, relatively few studies have examined the cumulative long-term impacts of successive conflicts on the sector across multiple decades.

1.1 Research Contribution

This review contributes to filling a knowledge gap in the literature on Iraq's water sector through four main dimensions. First, the extended temporal scope: While previous studies have focused on the impact of a specific conflict (e.g., [2]) or on documenting immediate damage (e.g., [3]), this review spans four complete decades,

enabling the identification of the cumulative effects of successive conflicts rather than treating them as isolated events. Second, the integrated multidisciplinary approach: The paper synthesizes analytical tools from water engineering, environmental management, political science, and governance studies, distinguishing it from studies that focused on a single aspect [2]. Third, the theoretical framing: The review employs Path Dependence theory as an interpretative framework to understand how impacts accumulate, drawing on theoretical work in this field [4]. Fourth, highlighting under-researched aspects, such as disruptions in hydrological time-series data [5] and the impacts on institutional memory [6]. In doing so, this review offers an integrated analytical framework that can inform future research.

2. Review Methodology

This paper adopts an extended narrative literature review methodology, drawing on some elements of non-systematic review. The review process included:

- Peer-reviewed scientific articles in the fields of water engineering, hydrology, and natural resource management
- Reports issued by international and regional organizations
- Comparative studies examining the water sector in conflict-affected countries
- Doctoral dissertations and primary research data

Sources were identified through academic databases such as Scopus, Web of Science, and Google Scholar. The selection prioritized peer-reviewed studies and authoritative reports that directly address water governance, infrastructure, and conflict-related impacts in Iraq and comparable contexts. The literature was classified according to main themes, including: infrastructure, institutional context, human capacities, data and monitoring, and post-conflict recovery. As a literature-based review, this study is limited by the availability and accessibility of published sources. Some technical and institutional data related to Iraq's water sector remain fragmented or unpublished, which may constrain the comprehensiveness of the analysis.

3. Conceptual Framework: Conflict as a Structural Pressure Factor

The relationship between armed conflicts and the water sector is addressed within the literature on the water-conflict nexus, which views conflict as a multiplier of pre-existing vulnerabilities in water systems [7]. This literature confirms that water is rarely a direct cause of conflict, but it is often one of the sectors most affected by its consequences. Fragility studies indicate that conflicts reorder national priorities, with resources directed towards emergency response at the expense of long-term investment, which particularly affects sectors of a cumulative nature, such as water resources [8]. This review draws on Path Dependence theory, which explains how past choices constrain present and future options [4]. It also utilizes the concept of "compound fragility" to understand the interaction of physical, institutional, and knowledge-based factors in conflict contexts [6].

4. Historical Context of Conflicts in Iraq

4.1 The 1980s

The Iran-Iraq War (1980-1988) contributed to the depletion of economic and human resources, which was reflected in the pace of implementation of irrigation projects and routine maintenance, while the water system continued to operate within the limits of available capabilities [2]. Unilateral upstream projects during this period subsequently affected water availability [19].

4.2 The 1990s

This period witnessed notable operational challenges, including damage to some water facilities and difficulty in providing operational and maintenance requirements, especially in urban areas [3]. The 1991 Gulf War resulted in the destruction of key water pumping stations and treatment plants, with long-lasting effects on urban water supply systems.

4.3 Post-2003

This period was characterized by structural changes in the public work environment, where service sectors faced challenges of continuity and reorganization under changing security conditions [1]. The limitations in institutional frameworks contributed to operational challenges [10].

4.4 2014-2017

Military operations in some areas led to localized damage to water facilities, necessitating emergency interventions to ensure the continuity of minimum supplies [11]). Case studies of the cities of Mosul and Ramadi have shown how local communities developed decentralized infrastructure to cope with supply interruptions, providing short-term resilience but creating long-term health and regulatory challenges [12] - [13].

5. Impact of Conflicts on Water Infrastructure

The literature indicates that armed conflicts lead to direct and indirect damage to water infrastructure, including pumping stations, treatment plants, and transmission and distribution networks. The inability to carry out

preventive maintenance during periods of instability also leads to accelerated deterioration of operational efficiency [14]. World Bank reports confirm that part of Iraq's water system operates partially below optimal design capacity due to cumulative effects and delays in certain rehabilitation works, a common pattern in countries affected by protracted conflicts [15]. Studies have shown that water infrastructure is often exposed to multiple episodes of damage before full recovery is possible [6]. Recent studies have revealed quantitative changes in surface water bodies in Iraq during 1984-2015, providing a quantitative basis for understanding the impact of conflicts on water resources [16].

6. The Institutional Work Environment in a Context of Instability

The literature illustrates that conflicts affect the institutional work environment by reducing organizational continuity and changing sectoral priorities. In contexts of instability, priority is given to securing basic services in the short term, while long-term planning becomes more constrained, a phenomenon documented in many countries emerging from conflict [17]. This effect is understood as a product of the general context, where the ability of any institutional system to function stably is affected by surrounding circumstances, not by isolated internal factors. The Clingendael report [10] identifies two major factors affecting the sector: a water allocation framework with limited implementation, and decentralization challenges that affect local water management.

7. Human Capacity and Accumulated Knowledge

The literature highlights that the water resources sector in conflict-affected countries faces challenges in maintaining technical expertise and accumulated knowledge, as a result of instability and diminished opportunities for training and capacity building [14] - [8]. In the Iraqi case, despite these challenges, the sector was able to sustain a degree of operational continuity leveraging available expertise; nevertheless, knowledge gaps gradually accumulated over time, affecting its capacity for development and modernization. Empirical studies also indicate that conflict exposure alters household water source choices and reliance on alternative supplies, reflecting broader disruptions in formal water service systems [18]. Schillinger's dissertation [6] documents in detail how armed conflict affects local water management in Iraqi cities, analyzing the loss of expertise and challenges in capacity building.

8. Hydrological Data and Monitoring System

The literature confirms that armed conflicts often lead to the disruption of hydrological monitoring stations and the loss of time-series data, which limits the capacity for modeling, forecasting, and risk management [5]. This challenge is considered one of the most structurally impactful constraints in the long term, as it affects the quality of decision-making and complicates the management of water crises related to drought and floods. Mason et al.'s study [16] demonstrates the potential of using remote sensing techniques to track changes in water bodies, providing an important alternative in the absence of ground data. Kharrazi, Sedighi & Rovenskaya [19] provide a comprehensive analysis of the water-energy-food nexus in the Tigris and Euphrates basin, identifying data gaps and methodological challenges. In response to these disruptions, alternative approaches such as remote sensing, predictive modeling, and strengthening station maintenance can help mitigate data gaps and support informed water management decisions. Such measures ensure continuity in monitoring and enhance the capacity of Iraqi water authorities to make strategic and operational decisions even under unstable conditions.

9. Indirect and Long-Term Impacts

Indirect impacts of conflicts include challenges to operational resilience, complication of shared water resource management, and increased reliance on short-term solutions. These factors also affect the ability of conflict-affected countries to deal with regional challenges, especially in transboundary basins [7]. Kibaroglu's study [9] emphasizes the importance of historical understanding of formal and informal water institutions in the Tigris-Euphrates region, analyzing water relations between Turkey and Iraq over the long term. Mengi and Akılı [20] provide an analysis of Iraq's efforts to address the water crisis through water diplomacy, focusing on Iraq's accession to the Water Convention and efforts to build regional cooperation.

10. Framework for Water Recovery in Post-Conflict Contexts

Recent literature indicates that water recovery in countries emerging from conflicts requires approaches that go beyond physical reconstruction to include restoring monitoring systems, supporting knowledge accumulation, and strengthening sectoral coordination [14] - [8]. These frameworks highlight the importance of a gradual transition from emergency management to long-term planning, in line with the national context and the specificity of water resources. The Clingendael report [10] provides a practical framework for improving water governance in Iraq, focusing on institutional reforms and coordination between different levels. Yousif, El-joumayle & Baban [21] emphasize the importance of the Water-Energy-Food nexus approach in conflict contexts, applying an analytical methodology to the Iraqi case.

11. Comparative Insight from Conflict-Affected Countries

Building on an understanding of these recovery frameworks, it is useful to examine the experiences of other comparable countries to draw broader insights. Comparisons with countries such as Syria, Yemen, and Afghanistan show that the challenges facing the water sector in Iraq fall within a broader international pattern, where institutional recovery lags behind infrastructure rehabilitation [8]. These comparisons help place the Iraqi case within an international analytical context, away from any narrow evaluative specificity. Common patterns include: destruction of water infrastructure, displacement of technical expertise, disruption of data collection systems, and the long-term nature of institutional recovery compared to physical reconstruction [6] - [14].

12. Discussion

The reviewed literature reveals several recurring patterns regarding the interaction between conflict dynamics and water sector performance in Iraq, which are further discussed in this section. The literature reviewed in this study suggests that armed conflicts have acted as a structural pressure shaping the evolution of the water resources sector in Iraq through multiple and overlapping pathways. The analysis highlights that understanding these impacts requires a historical and contextual approach, rather than focusing on superficial or isolated manifestations. The concept of "compound fragility" helps explain how physical, institutional, and knowledge-based challenges reinforce each other [6]. Institutional limitations may affect the management of reconstruction projects, disruptions in data availability can influence effective planning, and changes in technical expertise may affect the sector's capacity for development and modernization. The literature also indicates that recovery approaches focusing solely on technical aspects may achieve short-term results, but they remain limited in impact unless accompanied by efforts to enhance knowledge continuity and long-term planning [10] - [14]. This aligns with international literature on the challenges of recovery in fragile contexts, where institutional reform may require more time and gradual processes compared with the reconstruction of physical infrastructure [8].

13. Conclusion

This paper concludes that: Over the period 1980–2020, successive armed conflicts appear to have exerted cumulative and structural influences on Iraq's water resources sector. These impacts should not be viewed simply as the sum of individual conflict-related damages, but rather as a complex accumulation of physical pressures, institutional constraints, and challenges related to knowledge continuity. Current challenges reflect general contextual constraints associated with environments of instability. These challenges operate at multiple levels: physical infrastructure, institutional frameworks, human capacities, and data systems. They cannot be understood in isolation from the broader historical and security context. Sustainable recovery requires integrated approaches that consider technical, knowledge-based, and human dimensions simultaneously. The experience documented in the literature suggests that narrowly focused technical interventions, without attention to institutional continuity and knowledge preservation, are unlikely to achieve lasting results. Disruptions in hydrological data systems and changes in institutional memory represent important long-term challenges. These knowledge-related dimensions of conflict may influence the capacity for scientific decision-making and may also affect Iraq's negotiating position in shared river basins. Iraq's experience aligns with broader international patterns observed in conflict-affected countries. The challenges facing the water sector in Iraq are not exceptional but reflect general dynamics documented in the literature on fragility and post-conflict recovery. Future research could benefit from combining literature review approaches with empirical data from hydrological monitoring systems and institutional archives to better understand the long-term evolution of Iraq's water sector. Understanding the long-term structural impacts of conflict on water systems is essential not only for interpreting Iraq's past challenges but also for informing more resilient and adaptive water governance strategies in the future. Future water governance strategies in Iraq should not only focus on infrastructure reconstruction but also prioritize institutional resilience, and community engagement. Integrating these dimensions into policy frameworks will enhance adaptive capacity and long-term sustainability in the face of future instability.

AI Usage Disclosure

The authors used ChatGPT for language editing and improving the academic readability of the manuscript. All scientific content, analysis, conclusions, and references are the original work of the authors, who take full responsibility for the accuracy and integrity of the publication.

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BIOGRAPHIES OF AUTHORS

	Dr. Haider H. Al-Tameemi is a First Senior Chief Engineer specializing in hydraulic engineering, with over 25 years of experience in water resources management in Iraq. He holds a B.Sc. in Irrigation Engineering from the University of Baghdad, an M.Sc. in Water Resources Management from the University of Adelaide, and a Ph.D. in Hydraulic Engineering from Al-Mansour University. Currently affiliated with the Ministry of Water Resources' Center for Studies and Engineering Designs, Dr. Al-Tameemi has extensive expertise in dam and irrigation projects, hydraulic modeling, and environmental water management. He has contributed to national and regional studies focusing on sustainable water use and climate adaptation.
	Dr. Maha R. Alzaydi is a distinguished water resources engineer and dam design expert with a Ph.D. in Building and Construction Engineering (Water Resources–Dams Engineering). She has extensive experience in the Ministry of Water Resources, where she has led dam design, feasibility studies, and hydrological analyses. Her career spans academic teaching, engineering supervision, and international collaboration on Tigris and Euphrates basin issues. Dr. Alzaydi has contributed to numerous publications and participated in global conferences and technical delegations. Her expertise includes irrigation systems, dam safety, and water management strategies, with active involvement in professional and international water organizations.
	Dr. Ahmad J. Ibrahim is an academic and civil engineering specialist with extensive experience in concrete technology and construction materials. He holds advanced degrees in civil engineering and has contributed to both teaching and research in Iraqi universities. His work focuses on concrete behavior under extreme environmental conditions, including hot weather effects and material performance. Dr. Ibrahim has published several peer-reviewed papers in international journals and conferences, addressing sustainable construction practices and innovative material use. In addition to his academic role, he has participated in engineering consultations and collaborative research projects, contributing to the development of engineering knowledge and practical applications in the field.