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Water Weaponisation and Hydro-Coercive Negotiation: Rethinking Hydropolitics, Power and Interdependence in the Syrian Conflict (2012-2020)

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ABSTRACT: Between 2012 and 2020 in Syria, water was weaponised, but the manner of its weaponisation was constrained by the material and infrastructural characteristics of the country's water system. Weaponisation took the form of infrastructure targeting, flow manipulation and access denial; at the same time, forms of interaction were structured by interdependence and material constraints. Drawing on geospatial analysis, remote sensing and interview-based data, this article develops the concept of *hydro-coercive negotiation* to explain how access to water emerges through the interaction of asymmetrical power relations, coercive pressure and infrastructural interdependence. The findings identify four overlapping configurations through which actors engage in temporary and reversible forms of coordination; these are: mutual dependency, resource-based exchange, truce-based arrangements, and civilian solidarity. These dynamics challenge binary interpretations of water as a source of either conflict or cooperation, highlighting instead its role as a sociotechnical system that simultaneously produces coercion, constraint and negotiated interdependence.

KEYWORDS: Water weaponisation, Hydro-Coercive Negotiation, hydropolitics, hydrocoercion, water governance, Syria

INTRODUCTION

Water has emerged as a central element in contemporary conflict dynamics, functioning not only as a vital resource but also as an instrument of power, control and coercive negotiation. The weaponisation of water is not a new phenomenon in the Middle East. Historical and contemporary conflicts demonstrate that control over water has long been employed as a strategic instrument of warfare (Haj Asaad and Jaubert, 2014). Traditionally, however, such practices were largely confined to military confrontations and battlefield strategies. In Syria, the manipulation of water resources has taken on more insidious and wide-reaching forms, with water being deliberately used to target civilian populations and undermine public infrastructure. Further complexity is thereby added to an already protracted and multifaceted conflict.

From the early stages of the conflict, water access was systematically disrupted through a range of coercive strategies; these included deliberate service cuts, intentional flooding, destruction of irrigation systems, and contamination of supply sources. These tactics not only exacerbated humanitarian crises

but also deepened political and social divisions. Scholars have sought to conceptualise such practices by classifying them according to intent (strategic, tactical, psychological or coercive) or by the nature of the disruption (excess, deprivation, or degradation of water quality) (King and Burnell, 2017; Von Lossow, 2016). This typological approach is reinforced by studies that document the deliberate targeting and manipulation of water systems as instruments of conflict, thereby highlighting how water can be weaponised both directly and indirectly within broader strategies of control and coercion (Gleick and Heberger, 2014; Daoudy, 2020; Grech-Madin, 2025).

Building on this literature, the article proposes a refined typology of water weaponisation as it was used in the Syrian conflict. It identifies four primary modalities: (1) control over energy-related water infrastructure; (2) the destruction and looting of small-scale water supply systems; (3) the deliberate flooding or desiccation of irrigated areas; and (4) the intimidation of civilian populations through water-related threats. This typology provides a more nuanced understanding of how water has been deployed not only as a means of harm but also as a mechanism of control, coercion, forced displacement and political dominance.

Reducing water to a mere instrument of weaponisation risks obscuring the broader spectrum of interactions that have been structured around hydraulic infrastructures during the Syrian conflict. This article argues that, alongside coercive practices, opposing actors were engaged in limited and highly asymmetrical forms of coordination to secure access to water. These interactions frequently cut across established power hierarchies and were driven less by reciprocity than by infrastructural interdependence and survival imperatives. Rather than constituting genuine cooperation, they are better understood as forms of hydro-coercive negotiation in which access to essential resources is continuously shaped through coercion, constraint and strategic necessity.

Despite the rapid growth of research on water and conflict, several important analytical gaps remain. Existing studies rely predominantly on qualitative approaches, while relatively few employ integrated methodologies that combine spatial, hydrological and socio-economic data to enable a more comprehensive analysis. As a result, the complex interactions shaping water governance in conflict settings remain insufficiently understood. In particular, there is a lack of systematic analysis of how water is simultaneously mobilised as a tool of militarisation, coercive negotiation, and economic and political control by both local actors and regional powers; moreover, much of the literature has focused on inter-state dynamics, leaving intra-state conflicts comparatively underexplored.

To address these limitations, this article makes three key contributions. First, it refines existing typologies of water weaponisation by incorporating forms of energy-mediated control – particularly through fuel and electricity – as well as the strategic control of water pumping stations; it highlights their role in wartime governance and in the consolidation of political authority in post-conflict contexts. Second, it introduces the concept of *hydro-coercive negotiation* to explain how access to water in conflict settings is shaped by coercion, asymmetry and survival imperatives rather than by voluntary cooperation. Third, it provides original empirical evidence from Syria that combines geospatial analysis and interview-based data to document both coercive and coordinative practices and to demonstrate how water functions as a critical medium of survival, control and negotiated interaction.

By advancing this framework, the article contributes to a more nuanced understanding of water governance in conflict settings. It highlights how interactions over water unfold along a continuum that blurs the boundaries between weaponisation and negotiated interdependence, where coercion, constraint and coordination intersect.

The remainder of this article is organised as follows. The following section reviews the literature on water, conflict and hydropolitics, with particular attention to debates surrounding water weaponisation and infrastructural interdependence. Building on these discussions, the article develops the concept of hydro-coercive negotiation as an analytical framework for understanding water-related interactions in conflict settings. The subsequent section presents the methodology and data sources, combining

geospatial analysis, remote sensing and interview-based evidence. The section after that examines the multiple modalities through which water was weaponised during the Syrian conflict, including infrastructure targeting, flow manipulation, and indirect forms of coercion mediated through energy systems. The subsequent section analyses the emergence of hydro-coercive negotiation through multiple configurations of negotiated interdependence, including mutual dependency, resource-based exchange, truce-based arrangements and civilian solidarity. The conclusion reflects on the broader implications of these findings for the study of hydropolitics, infrastructure and wartime governance.

WATER WEAPONISATION AND HYDRO-COERCIVE NEGOTIATION: A CONCEPTUAL FRAMEWORK

The relationship between water and conflict has long preoccupied scholars of political ecology and resource geopolitics. Early debates, dominated by neo-Malthusian arguments, framed water scarcity as an inevitable driver of conflict between states (Homer-Dixon, 1994; Gleick, 1993). Over time, however, this deterministic perspective gave way to more nuanced interpretations that conceptualise water as a political object, that is, simultaneously a potential source of conflict, an instrument of coercion and a vector of cooperation (Allan, 2001; Wolf et al., 2003; Zeitoun and Mirumachi, 2008; Selby, 2013).

This shift has moved the analytical focus from water as a trigger of conflict to water as embedded within power relations and governance structures. Within this perspective, water can be deliberately mobilised to exert control, punish populations and restructure territories. The concept of water weaponisation captures these dynamics, referring to the deliberate use, manipulation or targeting of water systems as instruments of political or military strategy (Gleick, 2019; Haj Asaad and Jaubert, 2014; King and Burnell, 2017; Daoudy, 2020; Von Lossow, 2016). Empirical studies identify multiple modalities of such practices, including denial of access, infrastructure destruction, flow manipulation, and contamination (Von Lossow, 2016; Gleick, 2020; Haj Asaad et al., 2018; Daoudy, 2020). These interventions blur the boundary between military strategy and environmental violence, and produce humanitarian crises, ecological degradation and long-term disruptions to livelihoods.

While this body of work provides critical insights, it tends to privilege coercion and domination, often overlooking the constraints imposed by the material and infrastructural characteristics of water systems. Water infrastructures are not merely passive tools of control; they are complex sociotechnical systems characterised by spatial interconnectedness, technical rigidity and dependence on continuous operation. These features limit the extent to which water can be unilaterally weaponised, particularly in contexts where networks span fragmented and contested territories (Bakker, 2010; Linton, 2010).

Recent contributions to political ecology and infrastructure studies emphasise that infrastructures function simultaneously as sites of power and constraint (Anand, 2017; Easterling, 2014; Stel and van der Molen, 2015; Rodgers and O'Neill, 2012). From this perspective, infrastructures generate forms of relational dependency that bind antagonistic actors within shared systems. In conflict settings, such interdependence can produce interactions that do not fit neatly within the binary framework of conflict versus cooperation. Rather than existing as mutually exclusive dynamics, coercion and coordination often coexist and interact.

Building on these insights, this article introduces the concept of hydro-coercive negotiation to capture the specific dynamics through which access to water was structured in wartime Syria. Hydro-coercive negotiation refers to forms of interaction over water resources in which access is shaped by asymmetrical power relations, coercive pressures and infrastructural interdependence, compelling actors to engage in limited and contingent coordination under conditions of constraint. Rather than reflecting voluntary cooperation, these interactions emerge from the necessity of maintaining access to essential resources within systems that cannot be fully disentangled.

This conceptualisation shifts the analytical focus from water as a static weapon to water as a relational system that simultaneously produces coercion and constraint. It foregrounds how infrastructural

interdependence limits unilateral action while enabling selective and differentiated forms of control. In doing so, it challenges binary interpretations that position water as either a source of conflict or a basis for cooperation. The Syrian case, instead, reveals the constitutive entanglement of weaponisation, coercion and negotiated interdependence.

Empirically, hydro-coercive negotiation manifests through multiple overlapping configurations; these include: situations of mutual dependency, where shared infrastructures constrain disruptive action; resource-based exchanges, where access to water is traded for other essential goods; truce-based collaboration, characterised by temporary and instrumental coordination; and forms of civilian solidarity, where local actors develop adaptive mechanisms to secure access under conditions of infrastructural collapse. While analytically distinct, these configurations frequently intersect, reflecting the fluid and contingent nature of water-related interactions in conflict settings.

The Syrian conflict illustrates the relevance of this framework. Between 2012 and 2020, water was mobilised not only as a weapon of war but also as a medium of negotiation shaped by infrastructural constraints and interdependence. Dams were seized, pumping stations were deprived of electricity, and agricultural lands were flooded, dried or deliberately manipulated to punish communities and regulate production. At the same time, these interventions occasionally generated localised arrangements such as "water for fuel" or "water for electricity" exchanges, which were not evidence of cooperation per se, but rather were tactical adaptations within coercive environments. These dynamics demonstrate that water weaponisation operates within an entangled field of control, where negotiation emerges not despite coercion, but through it.

By foregrounding these dynamics, this framework contributes to debates on hydropolitics and wartime governance by showing that water infrastructures function not only as instruments of domination but also as relational systems that structure interaction, constrain violence, and shape the terms under which actors engage in fragmented political landscapes.

The following sections examine these dynamics empirically through the Syrian case and present the methodology adopted in this study.

METHODOLOGY AND SOURCES

This approach reflects a conflict-sensitive methodological framework adapted to conditions of restricted access and high insecurity.

The spatial scope of the study encompasses the entire territory of Syria, while the temporal scope covers the period from 2012 to 2020. This timeframe corresponds to the most intense phase of the Syrian conflict, whose frontlines became relatively stable in early 2020 following the decline of large-scale hostilities between regime and opposition forces.

The first phase of the study was initiated in June 2012 and ended in August 2015. It involved the collection of data on hydraulic infrastructures related to the supply of drinking and irrigation water, including dams, lakes, water networks, pumping stations, treatment plants and pipelines. These elements were georeferenced and digitised to enable spatial analysis. A geospatial mapping of actor activities was then conducted which focused on the evolution of territorial control, the shifting of frontlines between conflict parties, population movements, water access, and the status of hydraulic infrastructure. The second phase was initiated in September 2015 and is ongoing. It marks a transition towards an applied research initiative that extends the original methodological framework. It encompasses the development of water management strategies at both local and national levels, alongside capacity-building programmes and the design and implementation of infrastructure rehabilitation projects.

Primary sources of spatial and technical data included topographic maps, irrigation system blueprints and satellite imagery from two platforms: Landsat (TM 5 and 8 OLI; 30-metre resolution) and PlanetScope (3-metre resolution). Remote sensing techniques were employed to generate land-use data and assess

changes in irrigated areas. The imagery was analysed to track the evolution of land use and the spatial extent of irrigation throughout the conflict period.

To complement spatial and documentary data, three rounds of field interviews were conducted during distinct periods of the conflict: January 2013, May 2016, and March 2019. About 300 semi-structured interviews were conducted.

Given the risks associated with fieldwork in conflict settings, data collection was carried out under strict security protocols to protect both researchers and interviewees. To minimise exposure, GPS devices were not used; locations were instead identified through Google Earth and Bing Maps. The identities of all collaborators and interviewees remain confidential. The study area was divided into “mobility zones”, which were defined as areas within which individuals could move without crossing hostile checkpoints. Within each zone, trained collaborators collected data through direct observation and through semi-structured interviews that were based on a pilot-tested questionnaire.

Communication with field collaborators was maintained remotely via Skype, with questionnaires distributed by email. Additional communication tools, including WhatsApp, IMO and Messenger, facilitated coordination under constrained conditions. The questionnaire gathered information on damage to water infrastructure, access to drinking and irrigation water, changes in irrigated areas, and the actors responsible for such disruptions. Interviews were conducted with domestic water users and farmers, Syrian technical experts (including engineers, hydrologists, hydrogeologists, geographers, agronomists and political scientists), and representatives of civil society organisations. These provided critical insights into water governance dynamics, local coping strategies, and perceptions of coercion and negotiation surrounding water access.

Data analysis and verification were conducted in collaboration with a multidisciplinary team of civil engineers, agronomists and economists, many of whom were former employees of the Ministry of Water Resources and the Ministry of Agriculture and Agrarian Reform.

Data was analysed through a combination of spatial, quantitative and qualitative methods. Geospatial data was processed using Geographic Information Systems (GIS) to map water infrastructure, track territorial control, and identify correlations between conflict dynamics and water access. Remote sensing time-series analysis was used to detect changes in land use and irrigated areas across different periods.

Qualitative data from interviews and documentary sources was analysed through thematic coding to identify recurring patterns of water governance, coercion and coordination. Particular attention was given to interactions between conflict actors, which were categorised according to mechanisms such as coercion, negotiated access and constrained coordination.

A triangulation strategy integrated spatial, remote sensing and qualitative datasets, enabling cross-validation and case-based analysis of specific water-related interactions. This iterative process linked empirical observations to conceptual development, progressively refining and validating the notion of hydro-coercive negotiation against the collected evidence.

This study is subject to methodological limitations that are inherent to research conducted in active conflict settings. Restricted physical access required reliance on remote data collection, which may have introduced biases related to selective informant access and uneven spatial coverage. These constraints were partially mitigated through the use of 'mobility zones' and a trusted network of field collaborators.

Interview-based evidence may also have been affected by recall bias, strategic responses and political sensitivities, given the highly polarised context of the Syrian conflict. To reduce these risks, interview findings were systematically triangulated with expert assessments, geospatial analysis, remote sensing outputs and documentary sources.

Finally, while remote sensing provides valuable large-scale insights into land-use change and infrastructure dynamics, it cannot fully capture fine-grained or rapidly shifting local conditions,

particularly where water management practices are informal, intermittent, or difficult to detect through satellite observation alone.

WATER AS A WEAPON IN THE SYRIAN CONFLICT

During the Syrian conflict, water was weaponised through multiple and overlapping strategies including the manipulation of energy resources, the targeted destruction of hydraulic infrastructure, the deliberate flooding or desiccation of irrigated areas, and the systematic interruption of water supplies (Haj Asaad and Jaubert, 2014; Daoudy, 2020). Rather than constituting isolated practices, these dynamics formed part of broader strategies of territorial control and wartime governance.

Control of energy resources

During the early phase of the popular uprisings (late 2011/2012), the government maintained exclusive control over the energy sector, including the distribution of electricity, diesel and gas. In opposition-held areas, this control was strategically mobilised through the suspension of energy supplies. As diesel is essential for operating water pumping stations, these disruptions led to severe constraints on both drinking water provision and irrigation, and in some cases to the complete interruption of services (Haj Asaad and Jaubert, 2014).

In response, households increasingly relied on privately supplied water delivered by tanker trucks. Interview data and secondary sources indicate that the cost of 3m³ of trucked water – the amount needed to meet minimum daily needs over a month – represented between 10% and 20% of a civil servant's monthly salary; in besieged areas this rose to nearly 50%. Beyond affordability, the quality of transported water was frequently inadequate, raising significant public health concerns (Haj Asaad and Chamali, 2016 a).

By 2014, access to safe drinking water had reached critical levels across large parts of the Orontes River Basin. Existing studies (Haj Asaad and Jaubert, 2014) report that in towns such as Kafr Zaytah and Khan Shaykhun, less than one-third of the population had access to more than 20 litres per person per day, which is the emergency threshold defined by the World Health Organization (WHO, 2013).

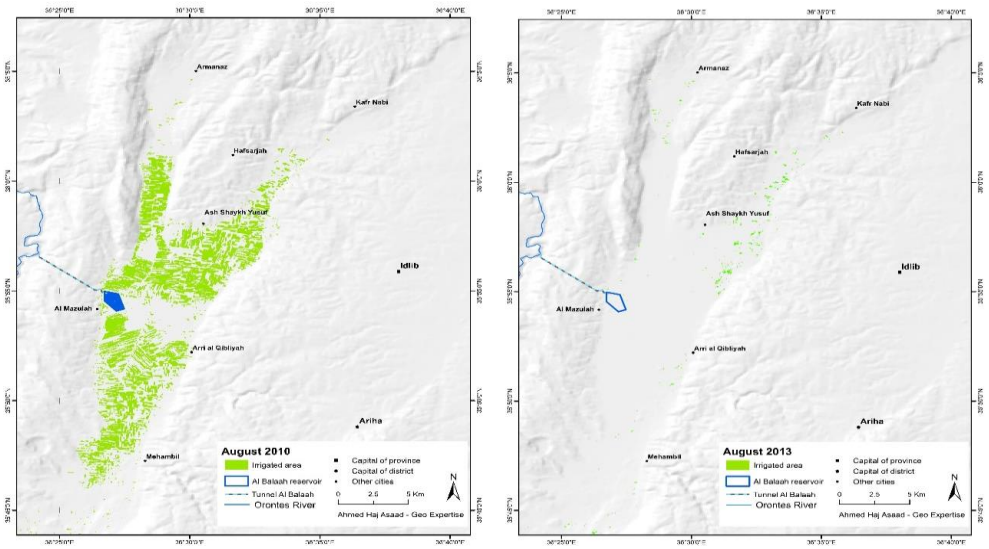
Agricultural systems were similarly affected. Spatial analysis and field reports indicate that in some areas electricity supply dropped to fewer than 3 hours per day during the 2012 agricultural season, whereas pumping stations required at least 12 hours of electricity to meet crop water requirements. This gap resulted in a sharp decline in supplementary irrigation and, in many cases, led to the complete suspension of summer irrigated agriculture (Haj Asaad and Chamali, 2016a, 2016b).

The cutting off of electricity to the pumping station supplying water to the Ar Ruj and Afrin irrigation schemes resulted in the almost-total disappearance of irrigation in the Ar Ruj Plain and to limited (because partially gravity-fed) irrigation in the Afrin irrigation network (Figure 1).

On the Ar Ruj Plain of Idlib Province, irrigation had formerly been sustained by the Ayn Az Zarqa pumping station, which operated using electricity. Following the withdrawal of regime forces from the area, the station was disconnected from the national power grid and subsequently subjected to looting. As a result, the entire 15,000-hectare Ar Ruj irrigation scheme dried up. Of this area, approximately 13,000 hectares (ha) of previously irrigated land were converted to rainfed cultivation of wheat and barley, while an additional 2000 hectares located near a military base remained inaccessible (Haj Asaad, 2022).

Similarly, in the Afrin district, northwest of Aleppo, the irrigation system serving 30,000 ha became largely inoperative due to a lack of the fuel needed to power the pumping stations. As in Ar Ruj, most of this land was converted to the production of rainfed crops, illustrating a broader trend of agricultural regression driven by conflict-related disruptions (Haj Asaad and Chamali, 2016c).

Figure 1. Irrigated area and water supply on the Ar Ruj Plain before the crisis (August 2010) and during the conflict (August 2013)



Taken together, these dynamics demonstrate that water weaponisation in the Syrian conflict frequently operated indirectly through the control of energy systems essential to hydraulic functioning. By disrupting access to the electricity and fuel required for pumping, conflict actors generated cascading hydro-coercive effects, including drinking water scarcity, irrigation collapse and the desiccation of agricultural areas. This illustrates how the weaponisation of water extended beyond direct attacks on hydraulic infrastructure to encompass the broader sociotechnical systems upon which water access depends.

The strategic targeting of hydraulic infrastructure for water and territorial capture

Systematic destruction and looting, particularly of small-scale irrigation infrastructure, constituted a recurrent feature of the Syrian conflict. Field-based observations and semi-structured interviews indicate that patterns of looting and destruction – predominantly by regime forces – primarily targeted wells and their associated equipment in Kafr Zaytah, Murk, Al Qusayr and Khan Shaykhun in 2013, 2014 (Haj Asaad and Jaubert, 2014), and again in 2019. These practices frequently involved the removal of water pumps and the seizure of drilling equipment, and in some cases they extended to the physical destruction of the wells themselves. In areas where groundwater lies at depths of 50 to 100 metres, the loss of such equipment rendered water extraction virtually impossible. As a result, between 2013 and 2015 the irrigated area supported by private wells declined by more than 95% in territories outside regime control.

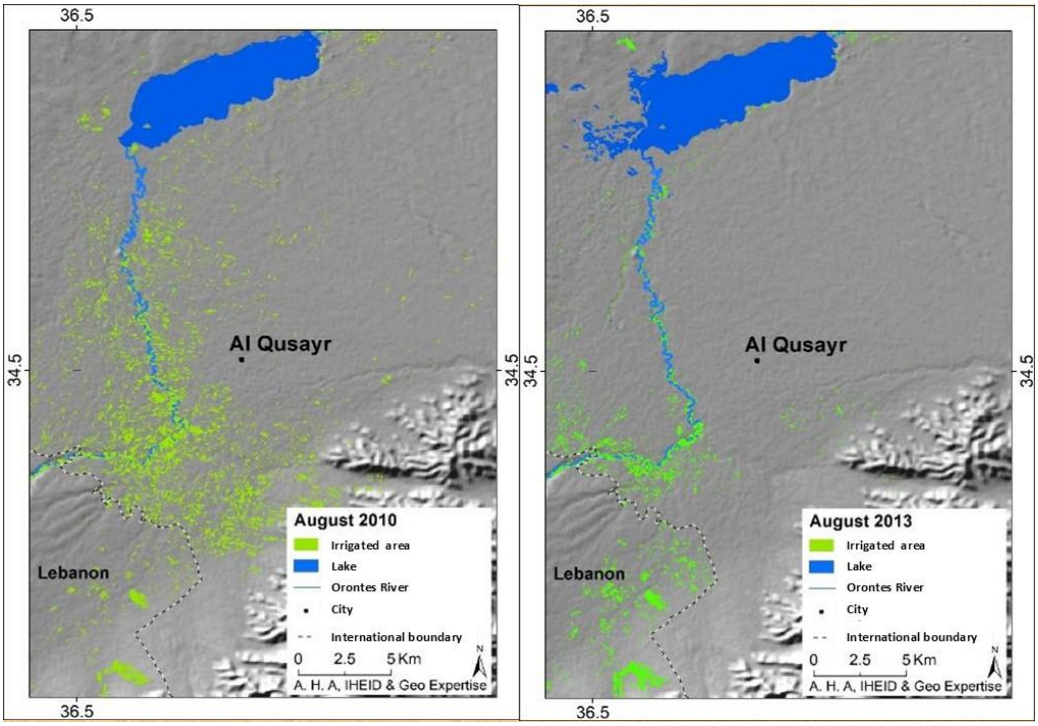
Available data further indicate that, in the Orontes River Basin alone, at least 40 water towers were reportedly destroyed by regime forces. Several pumping stations and distribution networks were also damaged. Particularly in the case of smaller facilities, determining whether these installations were deliberately targeted remains methodologically challenging due to the limited precision of certain weapons systems. A United Nations report (Miles, 2017), however, documents that three water stations and five towers were bombed within a three-week period, suggesting a pattern of repeated targeting.

Taken together, these dynamics demonstrate how water infrastructure has become embedded within broader military and regional strategies. Beyond their civilian function, hydraulic structures have been transformed into instruments for depriving populations of access to drinking and irrigation water, thereby undermining livelihoods. Such practices can be interpreted as indirect mechanisms of forced displacement that are aimed at compelling populations to abandon their land. This aligns with political

ecology analyses that emphasise how control over natural resources becomes central to strategies of domination in contexts of violent conflict (Peluso and Watts, 2001; Haj Asaad et al., 2018; Le Billon, 2001).

These dynamics were accompanied by widespread destruction of residential areas; this was particularly the case in villages located within irrigation schemes in Al Qusayr and around Lake Qattinah, where documented incidents between 2013 and 2014 affected at least 19 villages (Figure 2). Comparable patterns were observed in the irrigated zones of Al Ghab, where no fewer than eight Sunni-majority villages were targeted. Such patterns resonate with broader findings on the spatial targeting of civilian infrastructure as part of territorial control strategies (Le Billon, 2012).

Figure 2. Extend of the irrigated area of the Al Qusayr Region before the crisis (August 2010) and during the conflict (August 2013)



These attacks, directed at both hydraulic infrastructure and residential areas, appear to have served the broader strategic objective of preventing the return of displaced populations. In this context, displacement may be understood as a preparatory phase facilitating the implementation of pre-conflict development projects such as the Agropolis initiative in Al Ghab and the planned tourist complex around Lake Qattinah. More broadly, these dynamics reflect the converging of interests between regime-affiliated economic actors and armed groups seeking to consolidate territorial control, particularly in the Al Ghab and Al Qusayr irrigation schemes (Haj Asaad, Saadé-Sbeih, and Jaubert, 2018). The destruction of water systems thus functioned not only as a military tactic but also as a mechanism for reconfiguring patterns of water and territorial use in favour of pro-regime actors, echoing processes of accumulation by dispossession.

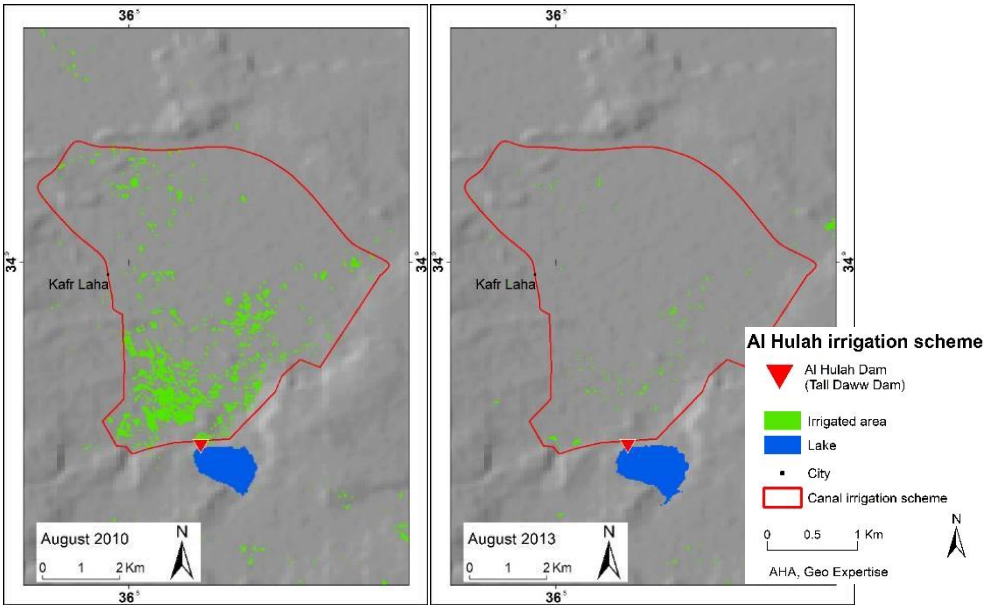
Crucially, the evidence presented here suggests that wartime conditions are not merely permissive environments for opportunistic destruction; they can also be actively exploited to carry out strategic acts of sabotage that facilitate the reconfiguration of control over land and resources. In this sense, the systematic targeting of water infrastructure can be understood as a form of infrastructural sabotage that undermines existing livelihood systems and renders territories economically and socially untenable for

their original inhabitants. This process, in turn, creates the conditions for coercive resource capture whereby newly empowered actors – often aligned with military or political authorities – are able to appropriate land and reconstitute patterns of access and ownership. Such dynamics extend political ecology debates by illustrating how violent conflict accelerates and intensifies processes of dispossession, transforming environmental infrastructure into a key medium through which power and territory are reconfigured (Peluso and Lund, 2011; Le Billon, 2012).

Manipulating hydraulic flows: Strategic water releases, desiccation and hydro-coercive control

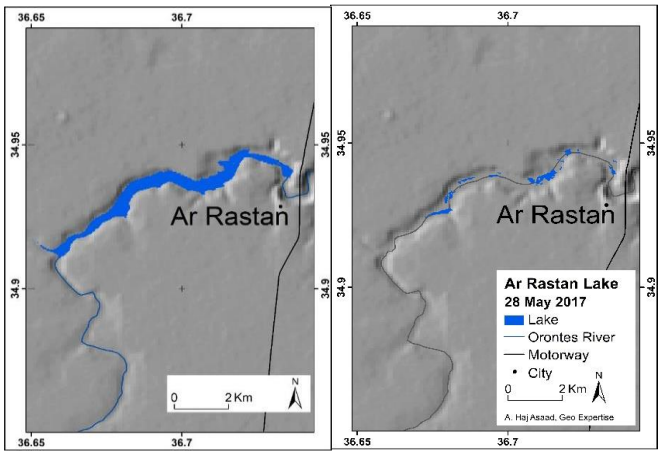
A particularly strategic and damaging form of water infrastructure weaponisation consists in opening dams and releasing stored water downstream when it is not needed and thereby generating shortages when demand is highest. The control of the Al Hulah Dam (Tall Daww Dam) provides a particularly telling example of this tactic, where the timing of the gate openings proved decisive. Events at the Al Hulah irrigation system exemplify what may be termed 'strategic release'. Until May 2018, the dam was under regime control, while the agricultural lands that relied on it for irrigation were located in opposition-held territory downstream. This situation enabled regime forces to exercise indirect economic control over opposition areas, manipulating agricultural productivity without occupying land or destroying infrastructure (Figure 3).

Figure 3. Irrigated area downstream of the Al Hulah Dam (Tall Daww Dam) area before the crisis (August 2010) and during the conflict (August 2013)



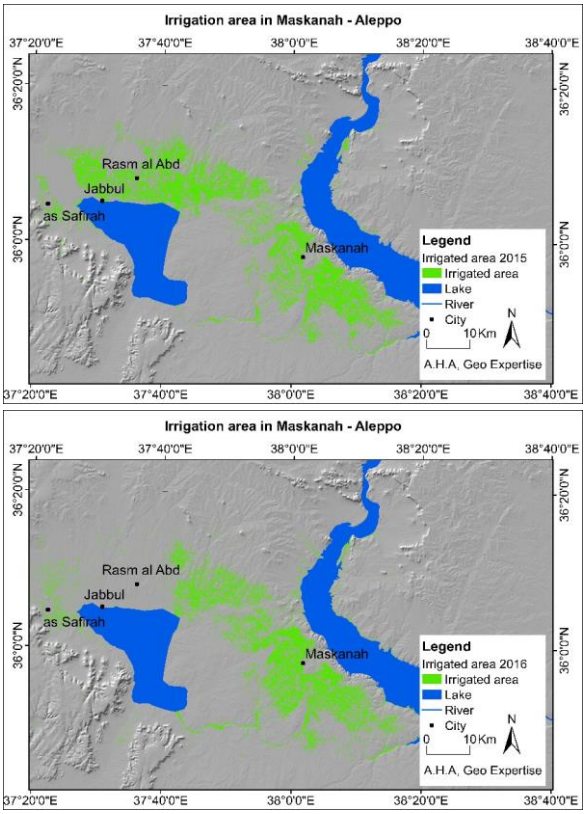
A similar approach was evident in the siege of northern Homs, where local residents depended on Lake Ar Rastan for irrigation, livestock, fishing and a modest inter-village trade of primarily food staples. Between March and April 2017, regime forces deliberately released water from the lake, draining it completely (Figure 4). Farmers were thus forced to install extended hoses to access residual water from natural streams, thereby increasing their irrigation costs by up to 300% (Feijoo Seara, 2019). Notably, the draining also coincided with the fish spawning season, which led to the loss of the fishing cycle, and the lake's disappearance disrupted the existing trade network that had relied on small boats for local commerce, thereby further exacerbating food insecurity.

Figure 4. Drying of Lake Ar Rastan, March and April 2017



Comparable tactics were adopted by Daesh (ISIS) in 2016 in the Euphrates Basin. Following its withdrawal from sections of the Maskanah Gharb irrigation network, Daesh blocked the main canal supplying irrigation water to areas that then came under regime control. Their aim was to preserve their exclusive control over agricultural production (Figure 5), and their action led to a reduction in those downstream irrigated agricultural areas.

Figure 5. Irrigated area in the Maskanah Gharb before the ISIS withdrawal (August 2015) and during the conflict (August 2016)



Taken together, these cases primarily illustrate the deliberate flooding, diversion and desiccation of irrigated areas as a modality of hydro-coercive control. Rather than relying on the direct destruction of infrastructure, conflict actors manipulated the timing and circulation of water flows to regulate agricultural production, generate economic pressure, and destabilise civilian livelihoods. In this sense, hydraulic infrastructures functioned not only as technical systems of water delivery, but also as instruments through which territorial control and political domination were exercised.

Militarisation and strategic control of water infrastructure

In the Ar Raqqa region, water towers assumed strategic military significance for the Islamic State (ISIS/Daesh) owing to their elevation, structural reinforcement and unobstructed 360-degree visibility (Feijoo Seara, 2019). Some reports suggest that Daesh systematically destroyed water infrastructure during its withdrawal from the city (Delmas, 2017), however such claims require careful qualification as a number of towers were in fact destroyed by international coalition forces targeting sniper positions embedded within them (Feijoo Seara, 2019). In this sense, water towers were not only used as military structures but also became legitimate military targets.

A similar tactical logic can be observed among other conflict actors. The Syrian regime likewise repurposed water towers as sniper positions, which in turn prompted opposition forces to target these structures during military operations. In the village of Babulin, in the Maarrat al-Numan area, control shifted repeatedly between opposing forces and the local water tower was ultimately destroyed by opposition fighters to prevent its continued military use.

Elsewhere in the Euphrates Basin, ISIS used flooding as a tactic to halt the advance of regime forces. According to a United Nations report, in early 2017 the level of the Euphrates River rose by 10 metres due to a combination of heavy rainfall and the opening of three turbines at the Tishreen Dam by Daesh; this resulted in widespread downstream flooding (Miles, 2017). In a later episode, Daesh flooded several villages in Dayr al Hajar, east of Aleppo, by pumping water up from Lake al-Tabqa on the Euphrates River (Aboufadel, 2017).

These dynamics primarily reflect the destruction and militarisation of water infrastructures, while also illustrating the deliberate use of flooding as a coercive tactic. In this context, hydraulic systems were transformed from civilian service infrastructures into strategic military assets through which actors in the conflict sought to control territory, obstruct military advances, and exert pressure on civilian populations. Water infrastructure thus became embedded within broader modalities of hydro-coercive governance that linked territorial control, infrastructural violence and strategic environmental manipulation.

Water control across borders: Hydraulic power and territorial expansion in Al Qusayr

Hezbollah, which maintained strategic ties with the Syrian regime, intervened in the Syrian conflict in support of regime forces. It leveraged its geographical position in the northern Bekaa Valley, from which the Al Qusayr irrigation perimeter is supplied through diversions from the Orontes River within Lebanese territory via five canals.

During the 2012/2013 agricultural season, Hezbollah authorities blocked these canal intakes, redirecting water flows back into the natural riverbed. This action targeted the Al Qusayr area, which was then under opposition control and largely hostile to the regime. As a result, irrigated area in Al Qusayr experienced a sharp contraction, while increased downstream flows contributed to the overflow of Lake Qattinah, which led to flooding of the surrounding agricultural land (Haj Asaad and Jaubert, 2014).

This case illustrates how a non-state armed group operating across borders mobilised its territorial control within Lebanon to influence water distribution in Syria. It thereby exemplified a form of transboundary hydro-coercive control in which water manipulation and military intervention are closely intertwined. This hydraulic intervention took place within a wider process of demographic and sociopolitical reconfiguration. It was followed by a broader military incursion into the area that resulted

in the displacement of local populations and strengthened Hezbollah's territorial control over the Al Qusayr region and its resources (Haj Asaad and Blanc, 2020).

These dynamics illustrate that hydraulic control can be exercised simultaneously as an instrument of economic coercion, a means to bring about demographic reconfiguration, and a geopolitical influence across contested border spaces.

Hydraulic intimidation through uncertainty

The drinking water supply to the city of Salamiyah has been used as a tool of intimidation, operating less through permanent deprivation than through recurrent disruptions and instability. Understanding this dynamic requires situating Salamiyah within its specific sociopolitical context. The majority of its population belongs to the Ismaili minority and a significant segment is perceived as politically opposed to the Assad regime.

Salamiyah joined the popular protests at their outset. The first demonstrations took place on 25 March 2011, with the largest occurring on 13 August 2011. These mobilisations undermined the regime's claim to be a protector of minorities.

At the same time, the city was exposed to growing external threats. The advance of the Islamic State (ISIS) in the eastern Hama countryside intensified insecurity, particularly following the April 2015 attack on the village of al Mabujah, northeast of Salamiyah, which resulted in the deaths of dozens of civilians (Syrian Observatory for Human Rights, 2015). This climate of fear created conditions that could be politically instrumentalised.

Within this context, water supply was repeatedly disrupted in 2015 (Oxfam, 2015), becoming a key mechanism of indirect coercion. Interviews with residents indicate that these interruptions were not perceived as incidental, but as deliberate. Some respondents questioned why – if indeed ISIS had intended to cut water access entirely – the infrastructure had not been permanently destroyed; they interpreted the recurrent but temporary disruptions as being instead indicative of a strategy aimed at producing uncertainty. In this reading, the regime benefited from this situation – and potentially instrumentalised it – to reinforce its control.

The strategic value of uncertainty lies in its psychological effects. Repeated but temporary interruptions generate a sustained condition of insecurity that is amplified by fears of potential ISIS attacks. Residents reported heightened anxiety and frustration linked to these recurrent outages, which underscored the fragility of both their physical safety and their access to essential resources.

The ambiguity surrounding responsibility for these disruptions further reinforced their coercive effect. The precariousness of everyday life was continuously signalled by the uncertainty over whether outages resulted from ISIS attacks, opposition activity, or regime practices. In this way, water cuts function not only as material constraints but also as instruments of psychological pressure, highlighting the perceived (in)capacity of competing actors to ensure reliable provision. In the case of Salamiyah, and partyle because of its sensitive sociopolitical configuration, the regime exercised pressure without resorting to the large-scale destruction observed in other areas.

The relationship between water-based intimidation and forced displacement is also significant. In some contexts, water denial operates not only as a mechanism of coercion but also as a means of legitimising violence. As documented by Amnesty International, the deprivation of water formed part of broader "surrender or starve" siege strategies (Amnesty International, 2017) in which populations were subjected to extreme stress and compelled to either submit or flee. Similar dynamics were observed in areas such as Ar Rastan and parts of the Damascus countryside, where access to water was instrumentalised to reinforce control and induce displacement.

These dynamics primarily illustrate the intimidation of civilian populations through water-related threats as a modality of hydro-coercive governance. Unlike direct infrastructural destruction or

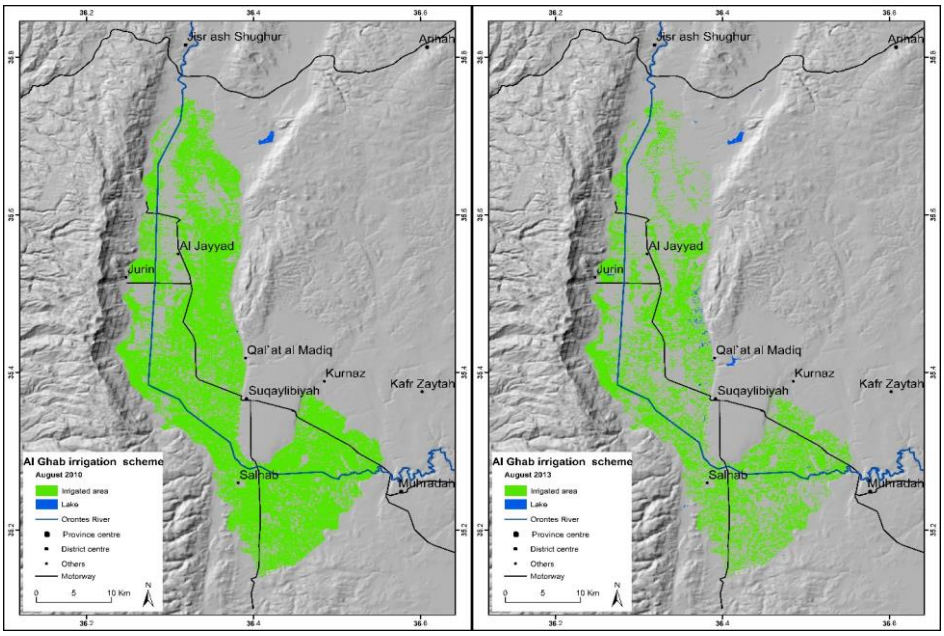
prolonged water denial, coercion here operated through recurrent disruption, uncertainty, and ambiguity regarding responsibility. The strategic value of these interruptions lay not only in limiting access to essential resources, but also in generating psychological insecurity and reinforcing civilian vulnerability and dependence.

Taken together, these dynamics demonstrate how uncertainty in water provision can function as a broader mechanism of hydro-coercive governance. Through intermittent disruption and selective reliability, water infrastructures become instruments for shaping behaviour, reinforcing authority, and restructuring relations between populations and competing power holders.

Hydraulic control and the manipulation of irrigation flows as instruments of coercion

Analysis of satellite imagery and data collected through semi-structured interviews reveals that the irrigation network in the Al Ghab Plain was subject to deliberate manipulation. The Muhradah Dam and its associated water distribution network supplying the Al Ghab-Al Asharinah system remained under the control of regime forces, enabling the selective regulation of water flows. This asymmetric allocation of water reflects the strategic use of hydraulic infrastructure to reinforce territorial control (Figure 6).

Figure 6. Al Ghab irrigated area before the crisis (August 2010) and during the conflict (August 2013)



During this period, irrigation water continued to be supplied to the western, pro-regime areas, while water delivery was cut off to the eastern canal which served opposition-held areas of the plain including the Afamia and Qastun reservoirs. As these reservoirs depended on pumped inflows, the suspension of pumping operations led to a sharp decline in water levels.

Quantitative analysis indicates that water flow within the Al Ghab irrigation network declined dramatically from an annual average of approximately 500 million cubic metres (Mm^3) in 2010/2011 to about 70 Mm^3 in 2012/2013, representing a reduction of more than sevenfold. The contraction of irrigated agricultural areas, however, was comparatively less pronounced, decreasing by approximately 30% in the eastern part of the plain while remaining relatively stable in the western sector. This discrepancy can be explained by farmers' increased reliance on groundwater abstraction to compensate for reduced surface water availability.

The northwestern section of the plain, in contrast, continued to receive relatively stable water flows, particularly areas supplied by the Jurin spring; agricultural production was thus allowed to persist under less constrained conditions (Haj Asaad, 2022).

These dynamics illustrate how control over water was exercised through the selective manipulation of irrigation flows. By restricting, redirecting or withholding water, actors in the conflict were able to exert pressure on both populations and agricultural systems while producing differentiated territorial outcomes. Rather than destroying hydraulic infrastructure outright, water was strategically regulated to sustain agricultural production in loyalist areas while weakening it in opposition-held regions. In this sense, hydraulic regulation operated not only as a mechanism of resource management, but also as a modality of hydro-coercive control through which political domination, economic pressure, and territorial reordering were enacted.

As we have described, Daesh employed similar tactics in the Euphrates Basin. Following its withdrawal from parts of the Maskanah Gharb irrigation network in 2016, it blocked the main canal supplying areas that subsequently fell under regime control, leading to a reduction in downstream irrigation.

HYDRO-COERCIVE TERRITORIALISATION AND THE DEFERRED WEAPONISATION OF WATER RESOURCES

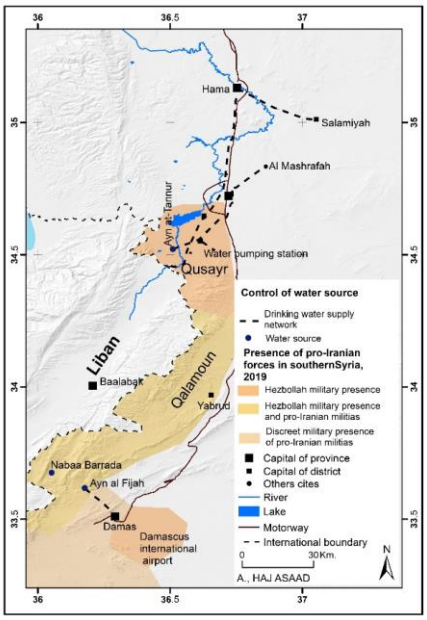
Within the context of the Syrian conflict, pro-Iranian militias have adopted a targeted territorial strategy aimed not only at conventional military control, but also at securing key water resources supplying major urban centres (Haj Asaad and Blanc, 2020). This approach aligns with a broader framework of water geopolitics in which control over hydraulic infrastructure functions as a critical instrument of power, influence, and long-term leverage.

Drawing on available data, the analysis traces the evolution of territorial control and the actors involved in Al Qusayr, with particular attention to control over water infrastructures. During the military offensive on Al Qusayr in the summer of 2013, Hezbollah consolidated its control over strategic water installations, notably the Ayn at-Tannur station (a key source supplying the city of Homs) and the Al-Umayrihah station (which serves a wider network including Al Qusayr, Ar Rastan, Hama, Salamiyah and numerous surrounding localities). Control over these infrastructures extended beyond immediate military objectives, enabling the actor to position itself within critical supply networks.

A similar dynamic can be observed in the military operations conducted in July 2015 against Az Zabadani, Madaya and the surrounding area, which were accompanied by a prolonged siege. Negotiations to lift the siege were conducted directly with Iranian actors, who imposed conditions including the forced displacement of local populations toward northern Syria. These arrangements culminated in the so-called *Four Towns Agreement* (2017/2018); this involved population transfers between Zabadani and Madaya on the one hand, and the Shiite localities of al-Fuah and Kafraya (Idlib province) on the other (Almodon, 2017a, 2017b).

These operations enabled the consolidation of control over strategic water sources supplying the Damascus metropolitan area, particularly the Ayn al Fijah spring. The combination of forced displacement and territorial capture of water infrastructure reflects a broader process of hydro-coercive territorialisation in which demographic restructuring and resource control are mutually reinforcing (Figure 7).

Figure 7. Water distribution network of Ayn al Fijah and Ayn at-Tannur



In this context, water infrastructure is not only a target or a tool of immediate coercion, but also an asset of deferred strategic value. By securing control over key supply systems, non-state armed actors acquire the capacity to exert pressure in future political and economic arenas, including post-conflict negotiations and reconstruction processes. At certain points in the conflict, access to potable water for a significant proportion of the Syrian population has fallen under the influence of such actors, transforming water into a geopolitical lever.

This argument remains cautious. Rather than implying a strategy of direct control over state decision-making, the Syrian case reflects broader regional patterns in which Iran has supported and coordinated with local and transnational militias to consolidate influence on the ground. These networks contribute to shaping governance dynamics indirectly, notably through their control over strategic resources.

More broadly, this case points to the emergence of a form of strategic resource control that intersects with questions of sovereignty, in which access to critical infrastructure – particularly water – becomes a lever of influence over state functioning. By consolidating control over the key water sources that supply the capital, pro-Iranian actors acquire the potential capacity to disrupt or condition access to essential services, thereby positioning themselves within the sphere of strategic decision-making.

Rather than implying direct or systematic control over state policies, this dynamic reflects a more indirect form of influence in which the ability to affect vital urban systems such as the water supply of Damascus can translate into political leverage, particularly in contexts of institutional fragility and post-conflict negotiation.

Existing scholarship highlights that Hezbollah operates as a hybrid actor combining military capacity with forms of parallel governance. Studies show that its influence relies not only on coercion, but also on its ability to control infrastructures, service provision, and strategic networks within a weakened state context (Khatib, 2021; Levitt, 2024). This ‘shadow’ or ‘parallel’ governance extends to key sectors including infrastructure and resource management, enabling Hezbollah to embed itself within the sociomaterial fabric of a territory. As further discussed in subsequent work, such practices reflect a broader shift from armed domination to forms of infrastructural and societal control (Levitt, 2023). According to this perspective, the control of strategic resources such as water can be understood as part of a wider process of territorial consolidation and political influence, rather than as an isolated or purely military tactic.

Water as a medium of exchange and wartime economy

An examination of resource-based exchange further illustrates how water infrastructures can underpin transactional forms of interaction.

During its control of northeastern Syria, Daesh assumed control over the Maskanah Gharb irrigation network. The group maintained the functionality of the system, using water as a strategic currency of exchange. Agricultural production consisted mainly of wheat and vegetables; these were exported to both regime-held territories and opposition-controlled areas and, in return, Daesh imported essential goods such as gas, sugar and cooking oil from these same zones. Water also became a tool for generating income. Daesh imposed annual irrigation taxes on farmers amounting to 3000 Syrian pounds per hectare (£S/ha) (Schaap, 2016) and claimed 5% of total agricultural output. It monopolised the trade of these goods by positioning itself as the sole intermediary. Daesh thus institutionalised water as an economic resource that was tightly controlled by its administration.

Another notable example of this approach occurred in 2016, when Daesh retained control of the Al Khafsah pumping station which supplied Aleppo and much of the surrounding countryside. Despite the city of Aleppo being divided between regime and opposition forces, water supply to both areas was maintained. This continuity was underpinned by a transactional agreement: in exchange for sustaining water provision, the regime delivered water purification chemicals and covered the salaries of station staff. This arrangement served the dual purpose of enhancing Daesh's legitimacy by enabling it to deliver essential public services, and allowing the group to collect additional revenue through the imposition of a water supply tax.

Water as a vector of hydro-coercive negotiation and interdependence

Although water has been widely documented as a weapon of war, the Syrian conflict demonstrates that its role extends beyond coercion and destruction. Across multiple contexts, water has functioned as a vector of hydro-coercive negotiation that shapes both tacit and explicit interactions between opposing actors; it also enables local communities to develop adaptive systems under conditions of extreme scarcity. Rather than reflecting stable or voluntary cooperation, both of these dynamics emerge from asymmetrical power relations, infrastructural interdependence, and the strategic necessity of maintaining hydraulic systems.

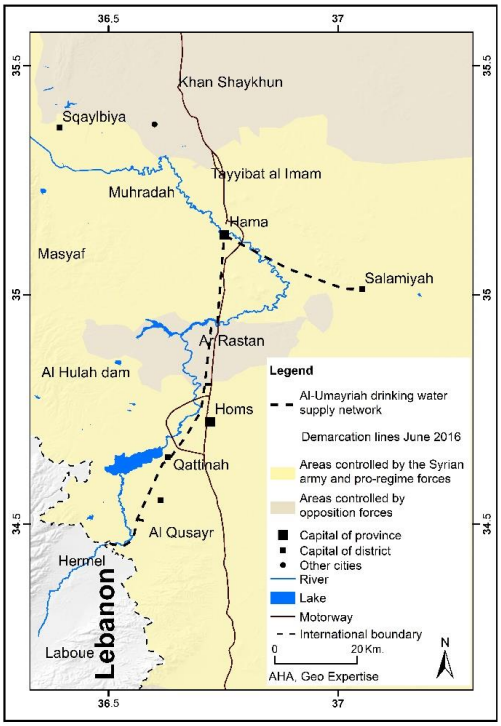
This interpretation builds on perspectives that conceptualise infrastructure as a site of both power and constraint in conflict settings (Anand, 2017; Easterling, 2014; Stel and van der Molen, 2015). Water infrastructures do not merely serve as instruments of domination; they constitute relational systems that materially connect antagonistic actors. Their spatial reach, technical rigidity and operational interdependence limit the scope of unilateral disruption, while simultaneously enabling selective and differentiated forms of control. In this sense, coordination is not opposed to coercion, but rather is often produced through it.

Within this framework, water-related interactions in wartime Syria can be understood as configurations of hydro-coercive negotiation in which access to water is continuously redefined through shifting balances of power, constraint and necessity. These configurations can be analytically distinguished into four overlapping forms: mutual dependency, resource-based exchange, truce-based arrangements, and civilian solidarity. While analytically distinct, these forms frequently intersect, reflecting the fluid and contingent nature of water governance in fragmented territorial contexts.

The Al-Umayrihah water supply network provides a particularly illustrative example of mutual dependency structured through hydro-coercive negotiation. The network extends across a wide geographical area that includes Al Qusayr, Qattinah, Ar Rastan, Hama, Salamiyah and more than 65 surrounding localities; it continued to operate even after parts of it fell under opposition control in 2012 (Figure 8). Despite possessing the technical capacity to sever the main pipeline, the regime refrained from doing so. This restraint was due to the fact that the same infrastructure supplied water to regime-held

urban centres such as Hama and Salamiyah. In this context, interdependence imposed clear limits on coercive action. At the same time, control was exercised selectively through the disruption of secondary pipelines that served opposition-held areas and through the obstruction of repair efforts. This combination of restraint and targeted intervention reflects a calibrated strategy in which infrastructural interconnectedness constrained total disconnection while enabling differentiated forms of punitive control.

Figure 8. Drinking water supply network of the Al-Umayrihah station



Beyond such structurally mediated constraints, water infrastructures also facilitated temporary and highly contingent forms of hydro-coercive negotiation between opposing actors. Evidence from Aleppo and Idlib illustrates how these arrangements emerged, functioned and ultimately unravelled. In July 2015, a ceasefire agreement in Aleppo enabled regime technicians to access opposition-held areas to repair infrastructure damaged by aerial bombardment. This interaction was strictly instrumental and short-lived, and hostilities resumed once repairs were completed and technicians withdrew. Similarly in Idlib, a reciprocal arrangement that is often described as "water for gas and electricity" linked control over water pumping stations to access to fuel and energy infrastructure. Opposition groups maintained water flows to the city while regime forces ensured the provision of fuel and electricity. This arrangement remained inherently unstable, however, and when the regime secured alternative water sources through well-drilling, it withdrew from the agreement. In response, opposition forces obstructed sewage outlets, triggering a severe public health crisis. Faced with deteriorating sanitary conditions, the regime was ultimately compelled to reinstate the arrangement.

These cases underscore the transactional, reversible and asymmetrical character of hydro-coercive negotiation. Rather than signalling durable cooperation, such arrangements reflect shifting strategic calculations that are shaped by infrastructural capacity, territorial control, and survival imperatives. Water infrastructures thus operate simultaneously as instruments of coercion and as constraints on its exercise; this generates conditions under which coordination becomes necessary, even among

adversaries. This dynamic reinforces the notion of negotiated interdependence, whereby conflict actors remain bound within shared systems that cannot be fully disentangled.

Importantly, hydro-coercive negotiation in wartime Syria is not limited to armed actors. Civilian solidarity constitutes a critical, yet often underexamined, dimension of water governance under conditions of infrastructural collapse. Across multiple locations, communities developed adaptive strategies to cope with systematic water shortages and the degradation of centralised systems. These strategies included manual well digging, collective water sharing, improvised energy production, and the establishment of local coordination mechanisms. In areas such as Tair Maalha, Tal Dahab, Al-Ghouta and Darayya, civilians mobilised technical ingenuity and social networks to secure access to water in the absence of formal governance structures.

These grassroots practices reveal the emergence of bottom-up governance systems that operate under conditions of constraint. In response to infrastructure destruction and recurrent water cuts, communities resorted to artisanal well-digging and developed informal systems of redistribution. Households with access to private wells often supported those without, while more-affluent residents subsidised water deliveries by tanker. Civilians also actively protected critical water sources from bombardment, particularly in urban environments where wells were scarce and essential. In Darayya, for example, residents constructed protective barriers of sand and debris over wells to shield them from aerial strikes. Improvisation also extended to energy production, with some communities producing diesel from plastic waste while others used bicycle-powered mechanisms to pump water to upper floors. Local councils further institutionalised these efforts by coordinating maintenance, distribution and financing, often with support from non-governmental organisations (Feijoo Seara, 2019).

Taken together, these empirical observations contribute to broader debates on wartime governance by demonstrating that the management of essential resources is not solely a tool of domination, but is also a domain of interaction structured by infrastructural constraints. While armed actors seek to instrumentalise water for strategic purposes, the material and networked nature of hydraulic systems limits unilateral action and generates conditions for negotiated coexistence. In this sense, water in conflict settings is best understood not simply as a resource to be captured or denied, but as a sociotechnical system that simultaneously produces coercion and constraint, conflict and coordination.

This perspective underscores how water functions as a critical mediator of power relations in fragmented and contested wartime political landscapes.

CONCLUSION

Water weaponisation constituted a central dimension of the Syrian conflict. This was manifested through the deliberate targeting of infrastructure, the manipulation of flows, and the restriction of civilian access to essential resources. Yet infrastructure was not uniformly destroyed. While large-scale hydraulic installations such as dams were often preserved due to their strategic and infrastructural importance, small-scale and community-level systems were more frequently targeted, looted, neglected or selectively disrupted. These practices formed part of broader strategies of territorial domination, population management and economic pressure, producing severe humanitarian and socio-ecological consequences.

At the same time, reducing water to a mere instrument of coercion risks obscuring the infrastructural constraints that shape wartime hydropolitics. Drawing on empirical evidence from Syria between 2012 and 2020, this article has shown that water-related interactions unfolded through overlapping configurations in which coercion, constraint and coordination were deeply intertwined. The possibility of unilateral control of hydraulic infrastructures was limited by their spatial interconnectedness, technical rigidity, and operational interdependence; these same features, however, enabled selective and differentiated forms of domination.

Within this context, conflict actors were frequently compelled to engage in temporary, transactional and reversible arrangements in order to secure access to water and maintain critical infrastructures. These dynamics are conceptualised here through the notion of hydro-coercive negotiation, which reframes coordination not as an alternative to coercion but as one of its modalities. Rather than reflecting genuine cooperation, such arrangements emerged through asymmetrical relations shaped by strategic necessity, infrastructural dependency, and the impossibility of fully disentangling shared hydraulic systems across fragmented territories.

The analysis further demonstrates that hydro-coercive negotiation operated through multiple and overlapping configurations; these included mutual dependency, resource-based exchange, truce-based arrangements, and forms of civilian solidarity. Importantly, these dynamics extended beyond interactions between armed actors. Civilian responses to infrastructural collapse included informal water sharing, collective well management, improvised pumping systems, and locally organised distribution networks; together, these revealed the emergence of bottom-up forms of coordination operating under conditions of extreme constraint. These practices underscore how access to water remained continuously negotiated even in the absence of formal governance structures.

By advancing this framework, the article contributes to broader debates on hydropolitics, political ecology and wartime governance by challenging binary interpretations of water as a source of either conflict or cooperation. It instead conceptualises water as a sociotechnical system that simultaneously produces coercion and interdependence, conflict and coordination. This perspective highlights the need to move beyond dichotomous understandings of resource conflict to examine how infrastructures themselves structure relations of power, dependency and survival in fragmented political landscapes.

More broadly, the concept of hydro-coercive negotiation offers analytical leverage for examining other conflict settings in which critical infrastructures connect antagonistic actors. Future comparative research could explore how different infrastructural configurations, resource systems and political contexts shape the modalities of coercion, negotiation and territorial control.

Finally, these dynamics raise critical questions regarding responsibility, reconstruction and post-conflict governance. Rebuilding water infrastructure in Syria cannot be approached solely as a technical or developmental challenge. Reconstruction processes risk reproducing pre-existing inequalities and reinforcing new forms of exclusion if questions of access, territorial marginalisation and infrastructural control are not explicitly addressed. In this sense, water governance constitutes not only a humanitarian and environmental issue, but also a central dimension of political reconciliation and spatial justice in post-conflict Syria.

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AI USE DECLARATION

Artificial intelligence was used for translation, grammar correction, and improving language fluency. It was also used to refine and enhance the summary.

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