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Infrastructure under pressure: Water management and state-making in southern Iraq

Michael Mason

Department of Geography and Environment, London School of Economics and Political Science, Houghton Street, WC2A 2AE, UK

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ABSTRACT

Water infrastructure is an active element of state-making in southern Iraq, although major failings in water governance have in recent years triggered violent protests. Informed by scholarship on state clientelism and the political ecology of infrastructure, I examine the conflict-affected trajectories affecting public water management in Basra governorate. The degraded water treatment network manifests a post-2003 political system structured by embedded clientelism and politically sanctioned corruption. However, broad categorisations of clientelism can miss context-laden political effects produced by the spatial and technological configurations of infrastructure. I consider the *state effects* of water infrastructure practices in Basra governorate–how water supply networks and treatment technologies project state (in)capacity by means of volumetric and qualitative control over water flows. The empirical focus is on compact water treatment units (CWTUs), which are the main technology of public water supply in Basra governorate. I undertake an analysis of the deployment and management of CWTUs, as experienced by local actors responsible for, or politically contesting, the workings of water infrastructure in Basra city. Clientelist practices targeting public procurement and maintenance contracts have disrupted and delayed the upgrading of water infrastructure; yet these practices were enabled by neoliberal state-building that promoted the privatisation of public resources. Shortfalls in state capacity to provide clean drinking water in Basra are compounded by the growing hydro-climatic unpredictability of water flows.

1. Introduction

In summer 2018 violent protests broke out in the Iraqi city of Basra, the capital of the country's oil-rich southern governorate. Hundreds of residents poisoned by contaminated water were pouring daily into hospitals, with at least 118,000 admissions by November (Human Rights Watch, 2019, p. 1), and media reporting of the outbreak inflamed discontent over breakdowns in public services, corruption and high unemployment. No official report was released on the sources of the contamination, but a scientific analysis of local water quality in 2018 revealed critical levels of various pollutants and high salinity, which the authors attributed, respectively, to insufficient raw water supplies and saltwater intrusion from the Persian Gulf (Almuktar et al., 2020). While Basra governor Asad al-Aydani blamed the federal government for failing to invest in water infrastructure, protestors set fire to numerous public buildings, Shi'a party offices and the Iranian consulate, signalling anger at Iran's political sway over southern Iraq (Asharq Al-Awsat, 2018). State security forces responded with lethal force, killing at least 20 demonstrators. Water supply failures remained a major source of public grievance in Basra (protests erupted again in summer 2020) and the city was also at the heart of a national uprising that began in October 2019. Civil society activists in Basra became the target of kidnappings and assassinations by armed groups (Robin-D'Cruz, 2021).

Amidst the complex, often bloody, politics of southern Iraq, international donors have promoted the delivery of clean water to Basra as a public good bridging ethno-sectarian division. The water supply crisis in Basra partly attests to the undoing of such development efforts since the US-led invasion in 2003. Early in the occupation of Iraq, the US Agency for International Development (USAID) funded the repair of the Bada'a Canal–the main source of freshwater for Basra–but this canal remained prone to structural collapse and other water supply failings. In June 2008, the Japan International Cooperation Agency (JICA) approved a development assistance loan worth US $395 million to the Iraqi government–the first payment in an ambitious programme, labelled the Great Basra Water Project, to improve the water supply system in Basra and surrounding areas. This included rehabilitation of the existing distribution network along with refurbishment and construction of water treatment plants (JICA, 2009). Yet, as with other donor-funded water

E-mail address: m.mason@lse.ac.uk.

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infrastructure projects in Basra, the JICA work stalled, becoming mired in allegations of fraud and corruption (Human Rights Watch, 2019, pp. 84-85; Iraqi Integrity Commission, 2018).

The absence of a reliable water supply for Basra's residents also reflects wider spatialities and temporalities of hydrological change. Iraq is highly dependent on transboundary inflows from the Euphrates and Tigris rivers, which are both decreasing as a result of upstream water control structures and climate change (Al-Ansari, 2016; Hasan et al., 2019; IOM Iraq, 2020). For four decades from the early 1930s, under what is labelled the "near-natural flow regime" for the Euphrates and Tigris (UN-ESCWA and BGR, 2013, pp, 60, 110). Iraq received a strong seasonal 'pulse' of water–a spring surge energised by snow melt in the headlands of both rivers. This pulse was the lifeblood of Iraqi agriculture and recharged, through flooding, the Mesopotamian marshes at the confluence of the rivers (Al Maarofi, 2015; Partow, 2001). By the late 1980s, following the build-up of hydraulic infrastructure in upstream riparian states (Turkey, Syria, Iran) and also within Iraq, the maximum spring pulse had fallen 89% (Al Maarofi, 2015, p. 49); and this predates the construction of the Ilisu Dam (2006–2018) in Turkey, which Iraqi scientists claim has halved water levels in the Tigris river (Kullab and Yahya, 2020). Downstream in Basra governorate, where the Euphrates and Tigris converge into the Shatt al-Arab river, reduced flows and high pollution loads are exacerbated in summer months by seawater intrusion (Kadhim et al., 2020; Zwijnenburg, 2020). Water withdrawn from the Shatt al-Arab supplies 60% of the water for treatment plants in Basra governorate but requires costly desalination and purification processes: it is often mixed with supplies from the Bada'a Canal to improve water quality. Since the 1990s the failure of the public water infrastructure to produce sufficient potable water has compelled city residents to buy drinking water from private vendors. Domestic tap water is used instead for cleaning homes and cars, watering and, if not turbid, washing and cooking.

With upstream sources heavily controlled by dams and other hydraulic infrastructure, Basra governorate is reliant on a water treatment and distribution network to produce clean drinking water for its residents. This paper examines the state effects of a specific water treatment technology–compact water treatment units (CWTUs)–favoured by the Iraqi government and donors. CWTUs are a well-established technology for water treatment designed to be easy to transport, install and maintain (Esposto, 2009; Micangeli et al., 2013). Individual units can be repaired or replaced without halting plant-wide water treatment, although the effective operation and maintenance of CWTUs requires trained staff, a predictable electricity source, and a regular supply of chemicals. There are over 300 CWTUs in Basra governorate, treating 72% of water supplied by public transmission and distribution networks (JICA, 2015, p. 3/7). This dependence on CWTUs attests to water infrastructure choices levelled down by the legacy of decades of armed conflict and United Nations (UN)-imposed economic sanctions. Drawing empirically on interviews conducted in Basra with water engineers, civil society actors, public officials and religious authorities, the paper explores the state effects of CWTU use. The key research question is: what are the effects on Iraqi state capacity from using this technology to produce public water? More precisely, how does CWTU use impact on, and remake, the territorial authority and legitimacy of the state?

Section 2 of the paper sets out the theoretical framing applied to study hydraulic infrastructure in Basra. Informed by scholarship on state clientelism, I adopt a theorisation of the post-2003 Iraqi state (including the local state in Basra) as a system of embedded clientelism and sanctioned corruption in which ethno-sectarian loyalties are secured through access to state resources. However, I avoid a top-down reading of clientelism, following instead those critical geographers and political scientists who research political favouritism by closely tracking the material and discursive workings of extractivist relationships in concrete settings. As part of this critical geographical approach, I argue that water infrastructure is an active element in Iraqi state-making, adding conceptual insights from infrastructure studies and political ecology. Section 3 outlines the conflict-affected trajectories of water management in Basra, highlighting the post-2003 (re)making of water infrastructure. In this context CWTUs play a pivotal role as a temporary technology while various mega-infrastructure fixes are promised, planned and routinely postponed: CWTUs emerge from, and reproduce, distinctive state relations. In Section 4 I undertake an empirical analysis of the recent management of CWTUs as experienced by local actors responsible for, or politically negotiating, the workings of water infrastructure. The paper concludes (Section 5) with summary observations on water treatment in Basra, arguing that the maintenance and upgrading of water treatment infrastructure is compromised by clientelist practices, contributing to the unconsolidated territorialisation of the Iraqi state.

2. State-making, water infrastructure and conflict

The post-2003 constitutional architecture of Iraq was crafted by the US-led Coalition Provisional Authority (CPA), culminating in a federal democratic system codified by the 2005 Iraq Constitution and approved by the majority of the population in a national referendum. This system features a power-sharing pact of ethno-sectarian apportionment (*Muhasasa*)–favouring Shi'a Arab and Kurdish elites–that distributes offices of state, ministerial posts, and senior civil service appointments to assist government formation (Dodge and Mansour, 2020; Mansour and Salisbury, 2019): political loyalties are secured by government appointments and the wider access they give to state resources (principally funded by oil rents), including government payrolls and public sector contracts. *Muhasasa* is typically portrayed, in political economic terms, as a system of embedded clientelism and government sanctioned corruption that, in the face of coercive threats, carves up public resources for particular groups (Abdullah et al. 2018; Hamilton, 2020; McEvoy and Aboultaif, 2020; Saouli, 2019).

In clientelist political systems, accessible public resources, including infrastructure spending, are prone to extraction by elites to deliver selective benefits for their favoured constituencies (Grzymala-Busse, 2008, pp. 642-43; Hicken, 2011, p. 300). However, there is an analytical need to show how transactional political practices are realised through infrastructure assets–the material and symbolic working of which enact particular state effects. As critical geographers and political scientists have argued, system-wide categorisations of clientelism can miss context-laden political effects produced by the technological, socio-economic and territorial configurations of water infrastructure (Coates and Nygren, 2020; Harris, 2012; Herrera, 2017, pp. 36-39; Hirvi and Whitfield, 2015; Mason, 2020). For example, Veronica Herrera's (2017) study of water reforms in Mexico systematically uncovers the shifting interplay of clientelist practices with different municipal settings, highlighting how local administrative choices over water provision reinforced or impeded clientelism. A parallel between failed water reforms in two Mexican cities (Herrera, 2017, pp. 173-198) and Basra is the embedding of clientelism in a new multiparty setting as actors competed for authority and resources.

As institutionalised by *Muhasasa*, politically sanctioned political corruption is seen as central to Iraqi clientelism: while the legal boundary for favouring interests is fluid and contested, 'corruption' in this case typically signifies extra-legal practices by which political parties (and their militias) seize state resources for private gain, including from looting, bribery and public contract kickbacks (Abdullah et al., 2018; Dodge and Mansour, 2020; Le Billon, 2005). At the same time, geographers have rightly cautioned against economistic notions of corruption that read off malpractices from predatory rent-seeking or state capture, suggesting instead an analytical focus on the material and discursive workings of extractive relationships in concrete territorial settings (Doshi and Ranganathan, 2017; 2019; Jeffrey, 2002; Robbins, 2000). In Iraq, overcoming the 'corruption' of Saddam Hussein's regime was a major justification for the US-led military invasion, legitimating in turn a neoliberal 'good governance' model of public infrastructure development (Dowdeswell and Hania, 2014; Le Billon, 2005, p. 685).

Yet *Muhasasa* practices are enabled by, and co-produce, this externally conceived model of state-building including, across southern Iraq, infrastructure development funded by international donors.

Clientelism in Basra governorate both mirrors, and clashes with, *Muhasasa* at the national level (Saleem and Skelton, 2019). The lucrative oil fields in the governorate, which provide 80% of the country's oil income, intensify the political stakes as access to oil revenue, ports and associated public contracts is a primary source of political power. Despite a decentralised system of power under the 2005 Iraqi constitution, there is a long-standing antagonism between the federal government and the Governorate Council for Basra over disputed access to resource rents, notably respective shares of oil production and export revenues (Al-Jaffal and Khalaf, 2021, p. 11). Under a local alliance system in place since the 2009 governorate election, rival Shi'a Islamist parties in Basra control different strategic resources, while their militias operate a shadow state of unchecked racketeering, notably from the smuggling of oil and drugs. The high levels of political and criminal violence in Basra reflect both the lucrative nature of extractivist practices and the ready access to weapons (Al-Jaffal and Khalaf, 2021, pp. 15-16; Saleem and Skelton, 2019).

The management of public water infrastructure is neglected and distorted by this partisan behaviour but cannot adequately be explained by system-wide notions of predatory rent-seeking or state fragility. Insights from political ecology and infrastructure studies allow an analytical focus on how, in a conflict-affected context, water supply and treatment technologies *in practice* articulate the presence (or absence) of the state. Pulses of water circulating through the conduits of public supply networks have political effects, projecting state (in)capacity by means of volumetric and qualitative control over water flows. State authority and legitimacy is likely to erode when there are systemic failings in the production of public water. As I detail in the next section, for those seeking to build and consolidate a new Iraqi state from 2003, water infrastructure renewal was seen as a key vehicle of state *territorialisation*.

Political ecology scholarship has shown how the development of water infrastructure is used to facilitate state territorialisation; that is, the state-led use of technologies and strategies to assert sovereign power over socionatural environments (Akhter, 2019; Clarke-Sather, 2017; Harris, 2012; Meehan, 2014; Mullenite, 2019; Swyngedouw, 2015). The related notion of hydrosocial territorialisation highlights the material and symbolic strategies enrolled to create "the spatial configurations of people, institutions, water flows, hydraulic technology and the biophysical environment that revolve around the control of water" (Boelens et al., 2016, p. 1). Across the Middle East, the construction of large hydraulic infrastructures is at the heart of many state-led scalings of hydrosocial territory, justified by overlapping narratives of nationalism, modernisation and development (Alatout, 2008; Hanna and Allouche, 2018; Harris and Alatout, 2010). In the analysis that follows, I seek to identify what Harris (2012) labels the 'state as socionatural effect'–how the widespread adoption of CWTUs, configured to support the public provision of clean water in Basra, produces specific political and hydrosocial effects that demonstrate *state capacity* (see also Mitchell, 1991). Water infrastructure interventions in post-2003 Iraq were a central part of state reconstruction efforts, expected to buttress territorial authority and legitimacy through the reliable circulation of potable water; instead, they have been buffeted by clientelist-driven extractivism and growing hydroclimatic stresses.

Water supply infrastructure can be a casualty of armed conflict through a host of direct and indirect effects that may accumulate over time (Mason and Khawlie, 2016; Schillinger et al., 2020; Sowers et al., 2017; Weinthal and Sowers, 2019; Zeitoun et al., 2014). A central claim of this scholarly literature is that infrastructure networks have become increasingly targeted by state and non-state combatants as a means of maximising the material, physiological and psychological impacts of military violence (Coward, 2008; Graham, 2006; 2010). Evidence offered includes examples of such warfare in Iraq, notably US-led bombing of Iraqi electricity infrastructure in 1991 and 2003, which on both occasions tiggered a collapse of water and sewerage systems dependent on electrical power (Coward, 2009, pp. 404–407; Graham, 2010, pp. 119-120). During the more recent armed conflict (2013–2017) between Iraq and US-led coalition forces against Da'esh (Islamic State of Iraq and the Levant), the control of dams facilitated the diversion of water flows for military purposes by opposing actors (Daoudy, 2020; von Lossow, 2020); for example, Da'esh closed the Falluja Barrage on the Euphrates in spring 2014 to flood agricultural land, while the Iraqi government released water from the Haditha Dam reservoir in summer 2014 to impede Da'esh attacks (Gleick, 2019, p. 7; Hasan et al., 2019, p. 276).

While southern Iraq was affected by the direct impacts of war, research on Basra identifies a complex assemblage of water infrastructure damage since the 1980s, relating more to the unravelling of *indirect* water service components–notably understaffed facilities, low operating budgets, a lack of spare parts and water treatment chemicals–than the degradation of physical structures (Kuttab, 1992; Micangeli et al., 2013; Zeitoun et al. 2017). Indeed, insights from humanitarian responses to the impacts of protracted conflict on water services across Iraq informed the adoption of a new urban systems approach on infrastructural warfare within the International Committee of the Red Cross (ICRC, 2015). A greater sensitivity, under this perspective, to the accumulation over time of incremental conflict-related impacts highlights, for example, the debilitating effects on operational water infrastructure of the UN economic sanctions regime on Iraq (1990–2003), which removed public investment opportunities and greatly reduced access to foreign-sourced spare parts and other consumables (Gordon, 2012, pp. 36-37; ICRC, 2015, pp. 45-47). Moreover, an understanding of infrastructure work within broader settings of conflict also opens analytical space to consider the structural violence of embedded clientelism in Basra governorate. From endemic contract and payroll malpractices by political parties to criminal racketeering by militia and tribal groups, water infrastructure projects are as exposed as other state assets–such as port and border crossings (Saleem and Skelton, 2019, p. 1)–to the legal and extra-legal enrichment of special interests. Next, I examine how the post-2003 water sector reform, as initially steered by the US and UK, failed to make good the key freshwater artery supplying Basra and, under a neoliberal privatisation drive, created water infrastructure contracts prone to abuse.

3. The post-2003 remaking of water infrastructure in Basra

At the inception of the CPA in May 2003, the US and UK–recognised by the UN Security Council as occupying powers responsible for the effective administration of Iraqi territory–soon acknowledged the ruinous condition of Iraqi infrastructure (Dobbins et al., 2009, pp. 109-111). The British, serving in Basra as CPA Regional Coordinator for southern Iraq and then, from 2006, as head of a Provincial Reconstruction Team, declared the restoration of essential infrastructure services a priority goal, providing financial and technical assistance for the reinstatement of water services across the governorate (Department for International Development, 2004; 2006). Large international pledges relating to the water and sanitation sector were made at the Madrid Conference on Reconstruction in Iraq in October 2003, notably by the US and Japan. By 2005, the US government had allocated $2.15 billion for the rehabilitation of water supply and sanitation in Iraq, much of which was wasted on private sector management failings (Dowdeswell and Hania, 2014; Special Inspector General for Iraq Reconstruction, 2013, pp. 79-82). Purged by the CPA of its Ba'thist Party members, the Iraq public works ministry was reconfigured into a Ministry of Municipalities and Public Works (MMPW): this new ministry assumed

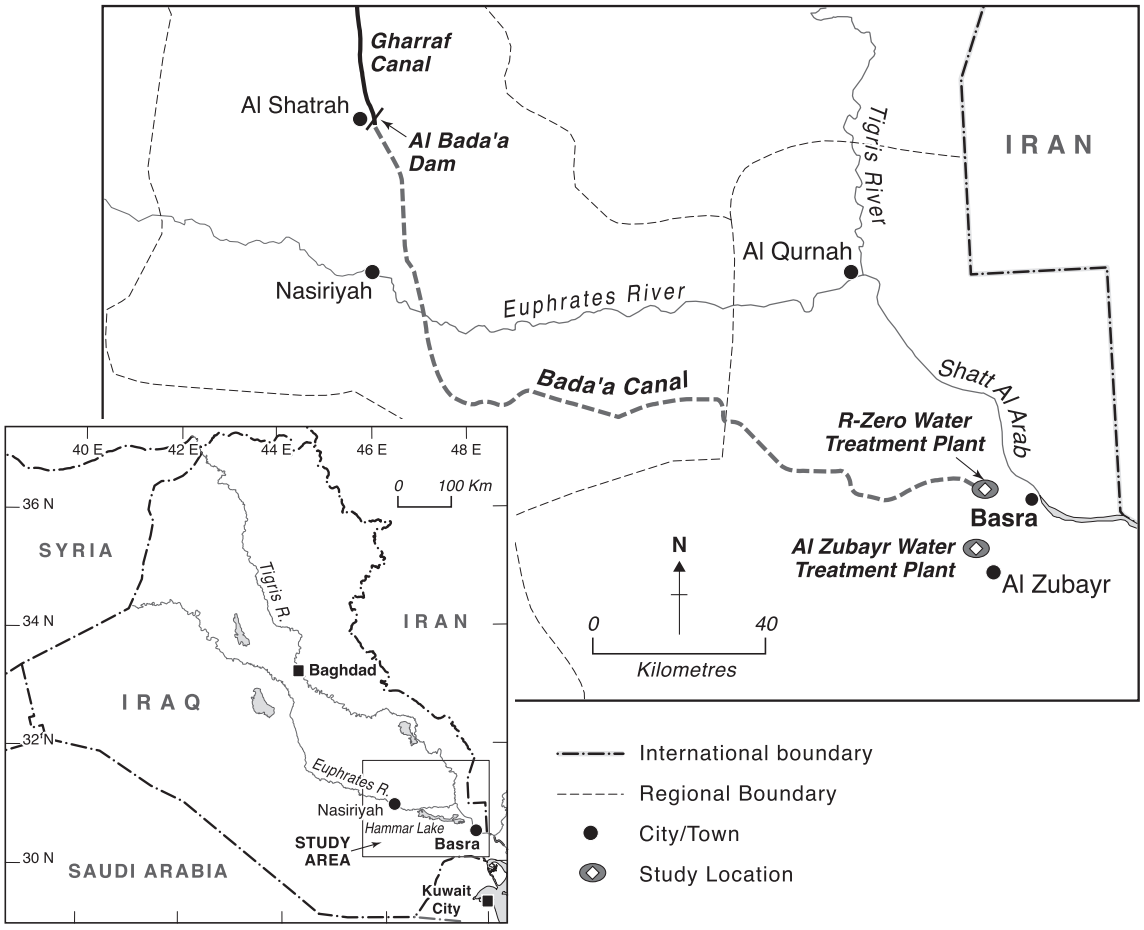

Fig. 1. Major waterways in southern Iraq (map by Mina Moshkeri).

management control over the Basra Water Directorate, with principal responsibility for water treatment and distribution across the governorate.[1] Despite UK claims of good working relations with the Iraqi government (Department for International Development, 2004: para 31), a former senior MMPW official claims that the UK-led Provincial Reconstruction Team in Basra consistently declined to collaborate or coordinate water infrastructure activities with the ministry, undermining its governance authority (personal communication, April 2020).

A key CPA priority in the south was to rehabilitate the principal artery of freshwater provision to Basra, the Bada'a Canal (Fig. 1)–a 240-kilometre open channel, built 1992–1997 under the financial constraints of the UN sanctions regime. The channel draws raw water from the Gharraf Canal (an ancient canal diverting water south from the Tigris River at Kut) at Al Shatrah, flows through a pumping station at Nasiriyah (feeding in water from the Euphrates) and then, via a second pumping station, supplies the R-Zero Water Treatment Plant near Basra airport (Al-Mahmod, 2019, pp. 81-85). In June 2003 most of the water received by R-Zero was pumped untreated to 15 water treatment plants within and outside the city, with 20% of the water filtrated and chlorinated by 25 CWTUs at R-Zero for piped supply to city residents. However, the lack of maintenance of the Bada'a Canal had resulted in excess sedimentation and eroded banks, substantially reducing the canal water reaching R-Zero and forcing Basra's water treatment plants instead to withdraw more saline, polluted water from the Shatt al-Arab (Nembrini et al., 2003, pp. 4-6). As part of a large US contract awarded in 2003, American engineering company Bechtel was paid US $23 million to dredge and repair sections of the Bada'a Canal and also refurbish 14 water treatment plants, including R-Zero (USAID, 2004).

These post-invasion repairs to the Bada'a Canal failed to address structural deficiencies caused by UN sanctions in the 1990s: funding shortfalls at the time of construction meant that the concrete lining of the canal and a second channel were incomplete (Special Inspector General for Iraq Reconstruction, 2006, pp. 4-5). Despite subsequent storage and pumping capacity enhancements by the Iraqi Ministry of Water Resources, the canal continued to suffer major water losses from a combination of evaporation, embankment failures, illegal water extraction and the rampant growth of aquatic plants which clog up pumps and filters. Up to two-thirds of the water supply capacity of the Bada'a Canal for Basra governorate is regularly lost, which was a significant contributor to the water crisis in the city in summer 2018. In Basra, a regular consequence of water flow deficits from the canal to R-Zero is the adoption of a rationing system (*marasheenah*) between city districts, where supply is alternated for two days at a time between Bada'a Canal water and saline water from the Shatt al-Arab (Al-Mahmod, 2019, pp. 84–93). Following the 2018 water crisis in Basra, and pressure from local politicians, in July 2020 the national government announced plans to convert the Bada'a Canal into a more efficient closed channel system (National Iraq News Agency, 2020).

Alongside these planned improvements to the Bada'a Canal, the Iraqi Government also reaffirmed its commitment in 2020 to the largest public water infrastructure project in the south–the Great Basra Water Project. This water supply improvement project, as noted in the introduction, was initiated in 2008 by a US $395 million development assistance loan issued by the Japanese Bank for International

[1] While the Ministry of Municipalities and Public Works and the Basra Water Directorate are responsible for water purification, treatment and distribution in the governorate, the Ministry of Water Resources is responsible for securing supplies of raw water.

Cooperation. Overseen by the MMPW, the project seeks to improve the quality and quality of water supplied to the cites of Basra and Hartha by the rehabilitation and construction of water treatment plants, the upgrading of water distribution networks and other supply facilities (JICA, 2007; 2009). Moreover, it serves a neoliberal territorialisation of water infrastructure consistent with the post-2003 vision set by the CPA for the private sector exploitation of Iraqi state assets. NJS Consulting Engineers, the lead engineering consultancy for the JICA-funded project, was charged with developing an institutional design for transforming drinking water provision in Basra governorate from a public service to a privatised delivery model, including the design of a private utility company and supporting water tariff structure. However, the Great Basra Water Project has experienced multiple delays, with its 2017 completion date repeatedly pushed back: in 2018 JICA issued a second loan payment of US $173 million with no public explanation for the construction delays. These delays reflect the reach into the project of the transactional demands of political parties and other special interests. Several sources claim that the project was held up on account of multiple actors demanding bribes and other illicit contract payments (Human Rights Watch, 2019, pp. 84-85; Saleem and Skelton, 2019, pp. 3-4).

Clientelist extractivism in Basra is closely tied to hydrocarbon rents as water services are subsidised by a federal budget dependent on oil sales. With its petrodollar reserves, the Iraqi government has issued tenders for mega-desalination plants to fix drinking water supply deficits in southern Iraq, thereby reducing the dependence on CWTUs, yet these projects are associated with allegations of contractual malpractices. In 2014 a US $220 million contract was awarded to a Japanese, Egyptian and French consortium for a reverse osmosis desalination plant at Al Hartha to process 200,000 m^3/day of water extracted from the Shatt al-Arab: this project is plagued by construction delays involving tribal disputes and alleged corrupt payments (Tollast, 2020). At a greater scale of hydro-territorial ambition, in April 2019 the Iraqi municipalities ministry awarded an Austrian company the project development and engineering contract for a seawater desalination plant at Al Fao, south of Basra city, with an estimated project value of US $1.8 billion. If completed, this would be the largest reverse osmosis desalination plant in the world with a capacity of one million m^3/day. The project also includes a water transmission system, comprising a pumping station and a 240 km pipeline network for supplying Basra and nine other cities in the governorate (ILF Consulting Engineers, 2019). In March 2021 a member of the Iraqi parliament referred the Al Fao desalination project to the Federal Commission of Integrity over alleged corruption relating to the construction contract.[2] However, corruption claims are themselves part of clientelist political bargaining, often used to discredit opponents and put pressure on government procurement decisions.

4. Managing unruly flows: treating public water in Basra

Even when enrolled to constitute state power, the materialities and technologies of water infrastructure produce diverse political–ecological effects that may escape or undermine governmental intentions (Anand, 2017; Meehan, 2014). Recent water crises in Basra signal system-wide infrastructure failings that are symptomatic of the incomplete hydro-territorialisation of the post-2003 Iraqi state; above all, the inability to create and secure a robust network for the reliable supply of potable water in southern Iraq. CWTUs represent a temporary technology for water treatment in southern Iraq applying a proven technical process of sedimentation, flocculation (applying aluminium sulphate powder), filtration (using pressurised sand filters) and gas chlorine disinfection (Esposto, 2009). As large-scale water infrastructure projects have been delayed, the reliance on compact units for public water treatment has increased within Basra's metropolitan area. In 2007 there were 83 CWTUs available for water treatment, providing 59% of estimated actual capacity of 529,500 m^3/day (JICA, 2007, p. S/7). By 2019 178 CWTUs were available for water treatment, supplying 83% of an estimated actual capacity of 963,630 m^3/day (data from Basra Water Directorate, 2020).

The growing dependence on CWTUs reinforces a water technology preference set in previous periods of conflict and endorsed by international actors (humanitarian organisations, donors) for complex emergencies; one in which *operational resilience* is favoured over more complex water treatment technologies, such as large reverse osmosis plants with high maintenance and electricity demands (Zeitoun et al., 2017). In principle CWTUs offer operational resilience on the basis of their modular design and redundancy: use can be scaled up or down, with individual units repaired or replaced whilst maintaining plant-wide water treatment (Micangeli et al., 2013). Of course, this begs the question as to why a water infrastructure system utilising compact treatment units in greater numbers still struggles to produce potable water. In this section, I examine: (1) the practical management experience of CWTUs in Basra city; and (2) how water management practices are understood by local actors as bound up with wider political and hydroclimatic processes. To do so, I look in detail at the use of CWTUs in the key R-Zero plant and the nearby water treatment plant in Al Zubayr, southwest of Basra city (Fig. 1). This is a purposive sampling according to treatment size and CWTU rehabilitation plans. R-Zero is selected as both as the largest CWTU plant in Basra governorate and the principal 'gateway' for the raw water supplied by the Bada'a Canal. Of the nine CWTU plants supplied with this raw water by R-Zero, Al Zubayr has the greatest treatment capacity. The plants were also selected as the Basra Water Directorate prioritised both for upgrading in the wake of the 2018 water crisis, so the management of their compact units was under active review and discussion by relevant actors.

Between August 2020 and January 2021, 13 semi-structured interviews were conducted with five managers/engineers running CWTUs in Basra, alongside four civil society actors engaged in local water management debates (including an environmental scientist), two public officials from the national ministries for water and health (environment protection department), and two religious figures. Interview questions covered–for managers/engineers–experiences of using CWTU technology (technical capacity, management, effectiveness, reliability, resourcing); and–for all interviewees–freshwater management issues facing Basra, eliciting views on water supply and quality challenges, responsibilities and future options.[3] Data on water treatment, quality and supply in Basra governorate was obtained from Basra Water Directorate, and an online search surveyed the reporting of water issues in local media. Methodologically, the semi-structured interviews were designed to reveal the context-laden understandings (Longhurst, 2016) of those managing CWTUs and others politically engaged with water management in Basra. The identification and interpretive analysis of the state effects of compact units draws on a methodological dialogue (Rule and John, 2015) where the theoretical framing is continually checked against empirical findings on perceptions of water treatment, supplemented by official data on water flows and quality. To what extent does

[2] See: Almasalah News, 9 March 2021, 'Suspicions of corruption affect the Basra desalination project'. https://almasalah.com/ar/News/206715/شبهات-فساد-تطال-مشروع-تحلية-مياه-البصرة-شركة-عبارة-عن-مكتب-وساطة-موظفين [*Arabic*]

[3] The English and Arabic (administered) participant information/consent forms are available on request from the author. Of the 13 interviews, eight were conducted face-to-face and five online. Covid-19 constraints reduced the number of interviews, which were still sufficient to cover management and engineering expertise on CWTUs in Basra, as well as prominent local perspectives on the politics of water infrastructure. Interview findings were supplemented and triangulated by communications with the Basra Water Directorate and a former senior official of the Ministry of Municipalities and Public Works. The research methodology received university approval for research ethics, risk assessment (health and safety) and data management.

the operation of CWTUs demonstrate the state's territorial and volumetric control over the delivery of clean public water? How is this impaired, if at all, by clientelist practices (government contracts, corruption, violence)? From this evidence, I assess how CWTU practices affect the capacity of the state in southern Iraq to exercise territorial authority and legitimacy over the public provision of water.

4.1. Managing CWTU plants

Public water supply (from CWTU and non-CWTU plants) reaches 85% of the Basra governorate population of 3.14 million and 95% of the city population of 1.38 million.[4] As noted above, CWTU technology supplies 83% of water treatment capacity for Basra's metropolitan area. Two water treatment plants utilising compact units were selected for assessment of CWTU performance–the R-Zero plant (also known as the Al Abbas water plant) serving Basra city and the Al Zubayr water plant, 8 km south-west of Basra city, which is supplied by R-Zero (see Fig. 1). R-Zero has the largest concentration of compact units in Basra city (34 CTWUs in 2020) and is also a strategic conduit for water distribution from the Bada'a Canal, which supplies 60% of the public water for the city. Up to 26,000–30,000 m^3/hr is received from the canal at R-Zero: of this 5000 m^3/hr is treated by compact units in the water plant for distribution by pipeline to city centre residents. The remaining water, after preliminary filtration, is sent to nine water treatment plants in and around Basra: one of these is the Al Zubayr plant (12 CWTUs in 2020), which receives 4000–5000 m^3/hr of this 'raw water' from R-Zero. Prompted by the 2018 water crisis, both plants were allocated major funding for compact unit rehabilitation.[5] In 2018 R-Zero received UNICEF support (funded from a US $6.1 million grant from the Australian Agency for International Development), while in 2019 Basra Governorate budgeted 983 million dinars (US $674,000) for contract work on the Al Zubayr plant.

Of the 34 CTWUs in the R-Zero water treatment plant, 16 were rehabilitated by UNICEF following major service failings in 2018 (interviewee 10). From August-October 2018, due to a decline in water supply from the Bada'a Canal, the plant was forced to extract saltwater from the Shatt al-Arab, which caused a rapid deterioration in water filters and pumps. Advised by water engineers, the UNICEF-directed humanitarian work prioritised rehabilitation of six CWTUs, with an enhanced treatment capacity of 400 m^3/hr per unit, which was completed in May 2019. Rehabilitation work on another ten compact units, at the standard capacity of 200 m^3/hr per unit, was undertaken later that year, along with the addition of new storage water tanks (interviewee 5). It is significant that this rehabilitation work did not increase the total treatment capacity of R-Zero (5000 m^3/hr), which is the maximum allocated to it from the Bada'a Canal. The key water management goal, set by the Basra Water Directorate, was instead the *maintenance* of existing treatment capacity–to create technical conditions that allowed the state to demonstrate (through the legibility of engineering specifications) its commitment to uninterrupted water treatment and distribution from R-Zero.

In practice, the assemblies of compact units at R-Zero are difficult to manage. In 2020 actual treatment was reported as only 3500 m^3/hr, rather than the 5000 m^3/hr total capacity. According to plant staff, CWTUs typically have a life span of 20 years with continuous maintenance necessary after the first five years of operation. Half of the units at the plant are over 15 years old and prone to malfunction (interviewee 6). Recent years have *not* seen shortages of the key treatment chemicals of aluminium sulfate and chlorine, although regular delays in access to spare parts are reported to have negative effects on water treatment. Since 2018 both UNICEF and the Supreme Religious Authority of Iraq have, in the absence of government support, funded new water pumps for the plant. The major operational challenges for the engineers are the rising staffing demands (the plant has three maintenance engineers) and costs of running a large number of old compact units. As at November 2020, 15 CWTUs were not running at their required efficiencies (interviewee 9). Nevertheless, water quality data support claims by plant staff that R-Zero is generally effective in treating water from the Bada'a Canal (interviewees 6, 9): since 2013 it has generally met Iraqi water standards for the reduction of turbidity, total suspended solids (TSS) and total dissolved solids (TDS). Water quality deficits are greatest when the plant is forced to treat water supplied from the Shatt al-Arab; thus, under these conditions in the latter half of 2018, raw and *treated* water from the R-Zero plant breached Iraqi TSS standards.[6]

Despite the recent donor-enabled upgrade of 16 compact units at the plant, over 80% of the water reaching the R-Zero plant from the Bada'a Canal is distributed as raw water to nine other treatment plants. Problems with onward transmission and treatment of this water attest to the weak volumetric control of public authorities: between 30 and 40% of the raw water is estimated to be lost due to leakages and illegal connections (WASH Cluster Iraq, 2019, p. 2). The piped distribution network in Basra city is over 50 years old, with planned upgrading part of the delayed Great Basra Water Project. In interviews water engineers highlighted 'illegal extraction' as a greater problem. While these violations are not systematically recorded, the public water piped by R-Zero is routinely tapped into by, amongst other uses, 'illegal housing' (*hawasim*), factories, car washes and horticultural businesses (interviewees 7, 9). Many local politicians have commercial land investments involving the unauthorised extraction of water, and a conspicuous lack of enforcement–evidence of clientelist deference to special interests–has encouraged others to follow suit (interviewee 9).

The highest share (4000–5000 m3/hr) of the raw water distributed by R-Zero goes to Al Zubayr water treatment plant, located in Al Shuaiba, which has 12 CWTUs–eight with a design capacity of 200 m^3/hr and four units at 400 m^3/hr. In 2008 four CWTUs had been rehabilitated with UNICEF funding, while in 2019 Basra Governorate committed funds to extensive maintenance and rehabilitation work. However, none of this planned expenditure took place and, with no money to pay contractors, none of the CTWUs at the plant were operational in 2020.[7] The sudden withdrawal of state funds, perceived as arbitrary by the water plant operator, is symptomatic of clientelist bargaining where payments switch erratically between governmental projects. This funding reversal disabled water treatment capacity at Al Zubayr. The four compact units rehabilitated by UNICEF were placed out of service and other compact units were not replaced. With the CWTU shutdown, there was no treatment of the water received from R-Zero aside from some chlorine dosing: all water delivered to residential areas in Al Zubayr district was therefore undrinkable (interviewee 7). Households were forced to rely even more on private water vendors, who mostly source desalinated water from a petrochemical plant in the Zubayr oil field. In 2008 the reverse osmosis unit at this plant had been rehabilitated, with DFID/UNICEF funding, to boost the availability of

[4] While sewerage treatment is not a focus for this paper, it is worth noting that about 65% of the city is covered by a municipal sewer pipe network. Basra city has a sewage treatment plant with a design capacity of 240,000 m^3/day, but operational neglect has resulted in low removal rates of organic waste and suspended solids (JICA, 2015, pp. 3/8-3/9).

[5] International humanitarian assistance at the time also included water desalination and purification units installed across Basra by the Red Crescent: https://www.mawazin.net/Details.aspx?jimare=10379.

[6] The Iraqi TSS standard (Law No. 26/1967) is 60 milligrams per litre (mg/l): in November 2018 the TSS levels at R-Zero were 144 mg/l for raw water and 90 mg/l for treated water. This compares to mean TSS levels (2014-19) at R-Zero of 81 mg/l for raw water and 27 mg/l for treated water (data supplied by Basra Water Directorate, 2020).

[7] In August 2020 local officials issued an urgent request to UNDP to fund CWTU rehabilitation and install new pumps at the Al Zubayr plant. Work started in 2021.

this private water supply (Reliefweb, 2008) as an alternative to *public* (state) water infrastructure. During a coronavirus wave in spring 2020, Al Zubayr municipality had to implore the desalination plant to donate supplies to residents lacking affordable access to clean water (Mawazine News, 2020).

Rapid urban expansion in the Al Zubayr area has outstripped the operational capacity of the water treatment plant at Al Shuaiba and a second local plant at Al Khitwa.[8] When the Al Zubayr plant was constructed in 1980, the population of Al Zubayr district was 150,000; by 2020 it had increased fivefold. To meet increased local demand before any mega-infrastructure fix comes onstream (e.g., the seawater desalination plant at Al Fao), Al Zubayr plant needs complete rehabilitation and additional compact units, appropriately resourced and staffed, to provide at least an additional 2000 m^3/hour of water (interviewee 7). However, this would require increased water from R-Zero, which exposes the system-wide vulnerability of state water infrastructure in Basra governorate. Local water treatment is compromised technologically not just by the high dependence of the CWTU network on R-Zero as a supply node, but also by the variable capacity of the Bada'a Canal to deliver water to R-Zero. This linear vulnerability along the canal reveals a state water network lacking spatial coverage and connectivity.

The vulnerabilities of a regional water treatment network over-reliant on supply from R-Zero was exposed for the Al Zubayr plant during the 2018 water crisis, as the public supply network suffered cascading failures in flow rates and water quality. Adoption of the *marasheenah* system of water rationing, with the R-Zero plant extracting water from the Shatt al-Arab, led both to a sharp reduction in water pumped by R-Zero to the Al Zubayr plant and levels of TSS far in excess of Iraqi water standards.[9] Along with the abrupt and unexplained withdrawal of funding for CWTU rehabilitation work at Al Zubayr water plant, there is also evidence of the misappropriation of state funds over water infrastructure in Al Zubayr district. In July 2017 the MMPW signed a contract with an Iraqi company for the construction of a new water treatment plant (29,000 m^3/day capacity) but terminated the agreement in August 2019 following allegations of corrupt contract payments (personal communication from former MMPW official, April 2020).

4.2. Participant perspectives on key challenges to state water management in Basra

The compact units that treat water in and around Basra are–with the engineers that operate and maintain them, the managers that monitor their performance, the politicians and administrators that direct their flows–a technology of government articulating particular state effects (Anand, 2017). Their growing deployment in the governorate, in the face of failed efforts to develop more centralised and technically advanced forms of water treatment infrastructure, evinces an unconsolidated hydrosocial territory: the state has limited volumetric authority and control over water for public consumption. At the same time, the state effects of CWTUs feed into, and make legible, broader biophysical and social-political changes. While these changes are not reducible to embedded clientelism, they are mediated by its extractivist field of governance. From the *participant* perspective of the interviewees–all involved in and/or contesting the governance of public water in southern Iraq–what are the most significant constraints on state water management and how do these relate to CWTU use?

Of challenges discursively recognised by local interviewees as *hydroclimatic* in source and impact, civic activists and the environmental scientist expressed most strongly the view that recent warming and droughts have significantly reduced water resource availability in Basra governorate (interviewees 1, 2, 3, 8). Seasonal water flows, already flattened by upstream hydraulic controls, are seen as ever more precarious, which is accentuating the saltwater intrusion of the Shatt al-Arab. Hydroclimatic impacts noted by interviewees included high temperature events, increased evaporation from water bodies, and growing levels of water salinity–all negatively affecting not just access to urban water but also agricultural production, notably south of Basra city. While they highlighted transboundary water stresses, only one civil society actor explicitly identified dam-building in Turkey and Iran as reducing water availability in Basra governorate (interviewee 2), although this was registered as a major concern by the official from the environmental protection department of the Ministry of Health (interviewee 11). For engineers running CWTU units, concerned more with daily practical challenges, the greatest biophysical problem was reported to be damaged equipment (pump inlets, filters) and reduced water quality caused by the accumulation of the aquatic plant, hornwort (interviewees 5, 9, 10): the rapid regional growth of free-floating hornwort may be related to rising temperatures (Mehdi, 2020). At R-Zero it is often necessary daily to remove hornwort from water supplied by the Bada'a Canal: clogging by hornwort can reduce the incoming flow rate by a quarter.

Demand for domestic water in Basra governorate is driven by population size, so it is unsurprising that the rapid population growth in the region was recognised both by state employees (interviewees 5, 6, 11) and non-state respondents (interviewees 1, 3, 12) as a major challenge for public water infrastructure. The governorate has an official population of two and a half million, but estimates reach five million, with recent growth due more to migration from elsewhere in Iraq than high net reproduction. These *socio-demographic* constraints on public water access were acknowledged by a federal environmental official as unequally shared (interviewee 11): over 330,000 of the governorate's citizens are not formally connected to the public water network (Human Rights Watch, 2019, p. 3): unauthorised tapping of waterways and pipelines by residents of unapproved housing (*hawasim*) exposes poorer communities to often untreated water. Water engineers interviewed saw this as a serious health risk, and some public water treatment plants supply *hawasim* districts (interviewees 3, 7). In Basra city, where public supply coverage is higher, most residents do not trust the quality of tap water for drinking and, if they can afford it, buy private water instead. There are more than 30 private water treatment plants (mostly reverse osmosis) in Basra city, which distribute water to residents by tankers.[10]

These differential circuits of public and private water provision have major political implications, for they demonstrate to Basrawis, shaken by recent water crises, that the state cannot serve as a guarantor for the reliable delivery of potable water to residents. Governance failings were regarded by most interviewees as the overriding cause for water supply and quality shortfalls, with references made to widespread illegal water extraction, tribal and militia threats impeding the work of water contractors, and budgetary cuts. These reasons all signify a *loss of authority* over the circulation of public water. Civil society interviewees pinpointed administrative failings in water planning not acknowledged by water managers–lack of technical expertise, transparency, and accountability (interviewees 1, 3, 8)–while one Shi'a cleric blamed successive regional governments: "the main reason for the crisis is mismanagement and violations of the water pipelines… it is very shameful to talk in 2020 that Basra governorate does not only have

[8] In 2009-2011 DFID funded the construction of five CWTUs at the Al Khitwa water treatment plant, Al Zubayr. https://devtracker.fcdo.gov.uk/projects/GB-1-201260.

[9] In 2018 the TSS levels for water *treated* by the Al Zubayr water plant peaked at 154 mg/l in October and 138 mg/l in November (data supplied by Basra Water Directorate, 2020).

[10] In 2020 the price of one ton of water (1018 litres) was approximately 8,000–10,000 Iraqi dinars (US $6) from private water vendors in Basra city. For public (tap) water, every quarter the Basra Water Directorate charges households US $20-50 (metered or estimated use): many refuse to pay because of service failings.

water unsuitable for drinking but also even unfit for washing" (interviewee 4).

There were multiple groups taking part in the 2018 protests in Basra, although a significant bloc was formed of Iraqi youth railing against the dominant coalition of local political parties (Robin-D'Cruz, 2021). Water shortages and contamination fed other grievances over other public service failings and unemployment. However, the failure to supply potable water is a ubiquitous physical sign of the *absence of legitimacy* of a governing system in which state institutions are seen to be captured by rent-seeking political parties and their militias. As expressed by the cleric: "The state is supposed to take the responsibility for delivering safe drinking water… this is the least the state can give, which is a citizen's right. Just as the state asks me to respect the law, I demand that the state gives me drinking water" (interviewee 4). Claims and counterclaims over water management and corruption are deeply politicised. It is instructive that, in response to the 2018 water crisis in Basra, the R-Zero plant was visited first by a representative of Grand Ayatollah Sayed Ali al-Sistani (the Supreme Religious Authority), then in January 2019 by Prime Minister Adil Abdul-Mahdi.[11] The Prime Minister praised the efforts of the R-Zero workers in providing clean water, while the Supreme Religious Authority representative decried governmental corruption and provided direct funding to R-Zero to purchase new water pumps (interviewee 8).

There is no clearer evidence of politically sanctioned corruption in Basra than *rival parties and their militias using violence for personal gain*. The coercive power exercised by these patronage networks in their pursuit of public assets and contracts dissolves state and non-state boundaries. As noted by a former Basra police chief: "the state is in the hand of the militias… the militias are just uncontrollable."[12] While apparently on a lesser scale than extortionist practices in the oil and gas industry, construction and repair work on public water infrastructure does not escape coercive demands from actors seeking the corrupt award of subcontracts or other payments (e.g. control over labour hiring). Civil society activists noted instances in which water treatment workers faced racketeering threats backed by violence, including at the Al Hartha desalination plant being constructed northeast of Basra. Similarly, a Chinese company contracted in 2018 to install water purification equipment at the R-Zero plant was forced to leave after unspecified militia threats and the work went to an Iraqi company (interviewee 3). Such extortionist activity, which is likely directed at other water management plants, has corrosive effects on infrastructure projects designed to deliver authority and legitimacy gains for the Iraqi government as a provider of clean drinking water.

5. Conclusion

The ongoing water crisis in Basra reveals *an unstable and incomplete hydro-territorialisation* of the post-2003 Iraqi state. Public water supplies are under pressure–there is an ongoing failure of the government to deliver sufficient flows of clean water to residents, while water infrastructure networks, already exposed to growing hydro-climatic and socio-demographic stresses, are buffeted by clientelist extractivism and politically sanctioned corruption. At the heart of the re-making of Iraqi state since 2003, *Muhasasa* features a transactional system between political parties where support is traded for access to public office and state assets. In Basra governorate, clientelist practices targeting public procurement and maintenance contracts have significantly disrupted and delayed water infrastructure investments. Under a local political pact, rival Shi'a Islamist parties in Basra control different strategic resources, while their militias operate a shadow sector of coercive extractivism. Embedded clientelism makes public expenditure on water infrastructure an accessible means for legal and extra-legal enrichment.

Under these volatile conditions, a 'temporary' water treatment technology–compact water treatment units (CWTUs)–assumed by default a dominant role in supplying public water for Basra's growing population. CWTUs now provide over 80% of water treatment capacity for Basra governorate and over 90% for the city. Above, I examine the workings of CWTUs in two water treatment plants–R-Zero and Al Zubayr–both of which were selected by the government for operational upgrades in response to the 2018 water crisis. The conduit for water supplied by the Bada'a Canal to Basra, the R-Zero plant remains for the city's residents a critical supply node in a creaking network of public water distribution. According to a local environmental scientist: "it [R-Zero] is now like a drip feed attached to a sick person" (interviewee 2). In the case of the Al Zubayr plant, the allocated state expenditure for rehabilitation never appeared, symptomatic of erratic, often unrealised, funding commitments for public water infrastructure under clientelist bargaining. While designed to deliver operational resilience, CWTU use in Basra emerges from, and reproduces, a precarious infrastructure. Water treatment plants employing CWTUs are under-staffed and under-resourced: their engineers work hard to maintain flows of public water but face daily challenges across an aged network.

Conceptually, this study contributes to critical geographical literature on clientelism and corruption in state-making by showing *how extractivist practices emerge from historical geographical conditions* that are not reducible to endogenous, universalising categories of rent-seeking or state capture. In the case of post-2003 Iraq this directs us to the state-building efforts of the US-led occupying authorities, institutionalising a political order of embedded clientelism structured along ethno-sectarian lines. The enrichment of special interests was fuelled both by a destabilising purge of government bureaucrats and a neoliberal drive to privatise state enterprises and resources, including water infrastructure services. Geographers have highlighted how neoliberalising governance has often modified, rather than supplanted, clientelist and corrupt forms (Brown and Cloke, 2005; Coates and Nygren, 2020; Doshi and Ranganathan, 2019): although the Iraqi case is a particularly violent example of externally imposed regime change and marketisation, it invites comparative analysis on clientelist dynamics under neoliberal transitions supported by foreign states.

Through its situated research on the practical workings of water infrastructure in Basra governorate, this study also offers *political ecological insights on state effects shaped by infrastructure*–how the workings of water supply networks and treatment technologies project state (in)capacity by means of volumetric and qualitative control over water flows. Informed by what Harris (2012) labels the 'state as socionatural effect', the analysis of CWTU use demonstrated context-laden effects on state authority and legitimacy. While the findings give evidential support to other studies showing how the materiality and scaling of water infrastructure articulates state interests (e.g. Mason, 2020; Meehan 2014; Mullenite 2019; Swyngedouw, 2015), it highlights the role of *infrastructure engineering* in trying to support a basic functioning of the state, supplying clean water. Indeed, the management of CWTUs in Basra reveals an autonomous field of professional engineering action that, in the absence of new mega-water treatment plants, negotiates–largely unsuccessfully–with state agencies over deficits in water service inputs (e.g. staffing, budgets, spare parts). These intricate and iterative workings constitute quotidian state effects–part of what Jessica Barnes labels the everyday politics of water (Barnes, 2014).

As CWTU plants are unable to deliver sufficient potable water for a growing population, *the socionatural effects of compact units tend to amplify hydrological constraints on Iraqi state-making*. For example, shifts in the flow regimes of the Tigris and Euphrates, affecting both the Bada'a Canal and Shatt al-Arab, require attention to the negative impacts of upstream hydraulic infrastructure and climate change. Shortfalls in state

[11] For the visit to the R-Zero plant by Prime Minister Abdul-Mahdi, see: https://baghdadtoday.news/news/72318/عبد-الم‌هدي-يتجول-في-م‌حطة [*Arabic*].For the Supreme Religious Authority involvement with R-Zero, see: https://www.facebook.com/100025364551857/videos/276365689885581/ [*Arabic*].

[12] Jalil Khalaf interviewed in January 2020 on Iraqi TV: https://youtu.be/FTDwQhC0jAw [*Arabic*].

capacity to provide clean drinking water are compounded by this growing hydro-climatic unpredictability of physical water flows. These transboundary changes remind us that the conditions for a stable and sustainable hydro-territorialisation in southern Iraq transcend domestic politics, for issues of water insecurity and climate change are regional. There is no international treaty for the Euphrates-Tigris basin, with Iraq exposed to unilateral flow alterations by Turkey and Iran. At the same time, embedded clientelism undermines the capacity of the Government of Iraq to engage, as a sovereign actor, in effective water negotiations with fellow riparian states (Syria, Turkey, Iran). Incomplete and crumbling water infrastructure in Basra has upstream political effects, signalling to neighbouring countries that Iraq has little interest in the quantity and quality of transboundary flows.

CRediT authorship contribution statement

Michael Mason: Conceptualization, Methodology, Data curation, Writing – original draft, Visualization, Investigation, Writing – review & editing.

Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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