

Water, climate change, and conflict

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Question

- *What are the interactions between water and conflict and instability?*
- *What evidence is there that water scarcity or water quality can be a driver of conflict?*
- *Will climate change increase incidences of water-related conflict?*
- *What evidence is there that water-sharing agreements can support peace and security, or improve broader bilateral relations?*

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1. Summary

There is a growing global water crisis. This is one of the most significant threats the world is facing. Rising water demands, degraded water quality, increasing water stress and scarcity, and competition between sectors are being driven by population growth, rising demands for food and energy, urbanisation, changing consumption patterns and climate change. Estimates suggest that four billion people live in areas with severe water scarcity for one month per year. Agriculture is the biggest user of freshwater, but the potential to increase agricultural water withdrawals is limited due to rising demands from other sectors.

The climate crisis is a water crisis. Climate change is one of the key drivers of the water crisis, simultaneously, climate change will also be experienced primarily through water including more frequent and intense floods and droughts and water-related disasters. Climate change is altering the global water cycle, increasing variability in availability and water stress and scarcity, as well as degrading water quality.

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Water can be a risk or threat multiplier for conflict and instability. It can also be a trigger for conflict at the local level. Gleick et al. (2020) argue that water crises are contributing factors that can influence the risks of conflict and instability, particularly when combined with other societal stressors. Water insecurity¹ is increasing and climate change is negatively impacting water challenges. This can compound existing fragilities and social stressors making conflict or migration more likely. Water as a trigger for conflict (where control of or access to water or water systems triggers conflict) rose from 27 events around the world in 2013, to 71 events in 2017 (OCHA, 2018). **However, a range of factors and intervening variables are likely to influence whether conflict arises.**

At the international level, whilst political tensions in some basins are increasing (e.g. the Mekong, and the Indus, Ganges, Brahma Putra systems), water historically has more often led to cooperation than conflict between countries. For example, from 1948-2000, cooperative events over international waters have outweighed conflictual ones by 2 to 1 (Wolf et al., 2003). Between 1948 and 2008 there were 38 acute disputes (ones involving violence) (De Stefano et al., 2010). Whilst 295 water cooperation treaties have been signed (Molnar et al., 2017). Conflict over water at the international level is often experienced in terms of political rhetoric, political tensions or economic acts, as opposed to violence. A key question is whether this norm will hold as the impacts of climate change are increasingly felt, which could increase pressure on governance structures or tensions in the absence of governance or water-sharing agreements.

Pathways linking water, conflict and instability

This paper considers interactions between water, climate change and conflict as a spectrum that includes protests, through political tensions to violent conflict, at different scalar levels of analysis. However, the local, intrastate and international levels are linked. For example, drivers of water-related risk in southern Iraq include poor governance and corruption, inefficient water use, destruction of water infrastructure during the war, and new upstream infrastructure in Turkey, Iran and Syria. It is unclear from the evidence reviewed for this report what the tipping point might be for when localised water conflict can spill over to other levels.

At the international level, water is often securitised and considered a sovereignty issue. High-profile examples of this include the Jordan River Basin, the Nile Basin and the Indus Basin between India and Pakistan. Tensions in political and economic relations can shape relations over water, with water being a medium through which countries express tensions.

A key source of tensions between countries sharing a basin is unilateral action related to dam construction or river diversion, particularly in the absence of transboundary

¹ UN-Water defines water security as “the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability” (UNESCO, UN-Water, 2020). Focusing on water security, as opposed to simply quality and quantity allows for consideration of multiple potential challenges through which water insecurity can interact with conflict and instability (see for example Sadoff et al., 2017).

institutions such as water sharing agreements or river basin organisations. New water infrastructure can change water flows, water quality, fisheries ecology and other hydrological functions in a basin with cross-border impacts. For example, Tajikistan's under construction Rogun Dam has been a source of tensions with Uzbekistan over potential impacts on the former's cotton industry. De Stefano et al. (2017) identified basins at risk in the next 5-10 years in Southeast Asia, South Asia, Central America, the northern part of the South American continent, the southern Balkans and parts of Africa. Potential basins at risk had the following characteristics: new water infrastructure is being planned or built in areas where transboundary agreements are absent and there is a concomitance of political, environmental and socio-economic factors that could exacerbate hydropolitical tensions, including climate-induced changes.

At the intrastate level, water allocations and water infrastructure can cause tensions between provinces. For example, in Pakistan there is a longstanding water tensions between the provinces of Punjab and Sindh over water allocations, the operation of water infrastructure and proposed water infrastructure projects. Protests in India at varying points between 2016 and 2019 illustrate how a multiplicity of drivers of water risk interact including: chronic water stress, pronounced seasonal variability in rainfall, demographics, inefficient water use in agriculture, poor water governance, and conflicts between national and state-based policies (Gleick et al., 2020).

At the local level, evidence suggests water as a trigger for violent conflict may be increasing. This may worsen as climate change further diminishes water security. For example, farmer-herder conflict in parts of the Sahel is increasing, and been linked to drought and access to water sources intensifying tensions and triggering conflict (IGC, 2018; EIU, 2020; Schaar, 2017). Climate change impacts on water may be influencing migration choices in the Middle East and North Africa through impacts on agriculture and the viability of rural livelihoods (Durrell, 2018).

In conflict-affected and fragile states, water insecurity and fragility can exist in a vicious cycle. Water crises can compound socio-economic risks related to poor governance and marginalisation, and trigger social friction, unrest, migration and violent conflict (Steduto et al., 2018). Institutional failures to address water-related challenges can act as risk multipliers.

Developing countries and weak states may be most at risk as they lack the financial, governance and technical capacity to navigate water insecurity challenges. Climate change and water insecurity interacting with other stressors could strain countries' abilities to meet their citizens' needs, contributing to resource competition, migration and conflict and instability. However, improving water management can contribute to building resilience in the face of protracted crises (Steduto et al., 2018).

The importance of intervening variables in influencing risk

Interactions between water, climate change and conflict and instability are complex and a number of intervening variables can mitigate or exacerbate water's risk or threat multiplier potential. Governance and institutions are perhaps the most important intervening variables at all scalar levels of analysis. For example, government agricultural policies in Syria were a driver of groundwater exploitation in rural areas, this increased communities' vulnerability to a climate-induced drought in 2007. The drought was one trigger for mass migration to urban areas,

interacting with a range of other drivers to contribute to instability and the subsequent civil war (Kelley et al., 2015). In Nigeria, increased farmer-herder conflict has its roots in environmental degradation, climate-induced changes and instability as drivers of migration; and poor governance and the decline of traditional mediation mechanisms (IGC, 2018). **Institutions and policy choices mediate the impacts of water insecurity on people and economies, as such the quality of institutions and governance is important.**

At the international level, the likelihood of tensions is usually increased by a set of converging and exacerbating factors (De Stefano et al., 2017). This includes biophysical/environmental factors such as climate change-induced water variability, water depletion; socio-economic factors such as population growth, rising demands, low GNI per capita, low adaptive capacity; and, political factors including how countries choose to respond to these challenges, and recent conflict. Whilst climate change could exacerbate tensions due to its impacts on water other factors are more likely to determine whether violent conflict arises (De Stefano et al., 2017).

Shared interests, institutions and institutional capacity can mitigate water's conflict-inducing potential at the international level. This includes water-sharing agreement, treaties, dispute resolution mechanisms and river basin organisations (RBOs). There is some evidence that once in place these institutions are resilient. For example, the Indus Waters Treaty has survived wars between India and Pakistan and in past disputes over water development both parties have resorted to agreed dispute resolution mechanisms. Currently only 84 out of 286 transboundary basins have joint water management institutions, with varying levels of capacity and only 9 out of 350 transboundary aquifers have permanent joint management mechanisms (EIU, 2020).

However, institutional quality and effectiveness is important. Water-sharing agreements and treaties are often snapshots of their time and do not reflect changing conditions such as climate change, population growth or levels of development. They can also be asymmetric and 'lock-in' power asymmetries between the riparian countries. The presence of water institutions does not necessarily mean that they are effective.

At the intrastate level a range of intervening variables, including prior relations between different groups, social contracts, adaptive capacity, effective natural resource management, presence of dispute resolution mechanisms, governance and institutions play important roles in mitigating or perpetuating risk (see for example, Tubi & Feitelson 2016). Water scarcity, water stress and degraded water quality are not simply biophysical in nature, but social: the result of political economy factors, institutions, governance and political decision-making. Whether water acts as a risk or threat multiplier is determined by a range of physical, social, and political variables.

Benefit sharing, water diplomacy and Blue Peace

Water can support regional cooperation, stability and peace. Cooperation over water by countries can extend to other areas such as peace, security and prosperity through positive impacts on food security, economic stability, improved regional integration such as power sharing pools, and better trade relations (Molnar et al., 2017). There are four types of benefits that can be derived from international rivers by riparian countries: benefits to the river, benefits from the river, reduction of costs because of the river, and benefits beyond the river.

The Senegal River Basin is one of the strongest examples of benefit sharing due to water cooperation. Riparian countries have developed innovative forms of shared ownership of infrastructure (referred to as common works), governance and joint financing. The Diama and Manantali Dams are jointly owned and managed, and were jointly financed through the Senegal River Development Organisation with a cost-sharing agreement. The two dams provide benefits including energy, drinking water provision, irrigation, flood control and prevention of saltwater intrusion.

Blue Peace “refers to water cooperation across borders to foster stability and sustainable development” (EIU, 2020). Blue Peace is ‘positive-sum’: countries enjoy more benefits from working together than they would separately, with benefits including enhanced energy security, protected biodiversity, reduced flooding and drought, and optimisation of investments (EIU, 2020). Using a range of diplomatic, political, technical and financial tools can transform water from a source of dispute to an instrument of cooperation (EIU, 2020). Promoting Blue Peace will require political will, stronger institutions, developing trust, inclusive decision-making, evidence-based decision-making, and finance.

Water diplomacy argues that water is a means to contribute to broader goals of peace and stability. It involves applying diplomatic tools such as negotiations, fact-finding missions, and the establishment of consultation platforms to existing or emerging disagreements over shared water resources with the aim of solving or mitigating these for the sake of cooperation, regional stability and peace (Schmeier, 2018). It can involve state and third party actors. Examples of third party interventions include the East African Community, through the Lake Victoria Basin Commission, helped Kenya and Tanzania sign a MoU on management of the Mara River (Petersen-Perlman et al., 2017).

The evidence base

There are relatively large bodies of literature related to water and conflict, and conflict and climate change. This rapid literature review provides a snapshot of this literature and largely focuses on literature from 2017 onwards. Whilst in the literature, water and climate change are often linked to conflict and instability through climate change’s impacts on water security, the general consensus in the literature reviewed for this report is that this does not mean there are direct causal linkages. Establishing whether or not incidences of water-related conflict, or conflict over water is increasing, is challenging and contested. For example, whilst sources such as OCHA (2018) report that the number of incidences has risen, there is a lack of comparison data (for example, the number of cases that were resolved cooperatively).

2. Water and climate change

The water crisis

The water crisis is one of the most significant threats the world is facing (WEF, 2019). The World Economic Forum define the water crisis as a “significant decline in the available quality and quantity of freshwater” (WEF, 2019). The climate crisis is a water crisis: climate change will primarily be experienced through water, including changes in water availability, water quality, the frequency and intensity of floods and droughts, water-related disasters such as storm surges, and sea level rises.

There is strong case for strengthening water security to tackle the water and climate crises, and support human wellbeing and economic development. Water is vital for human health and well-being, all forms of production including food, energy and industry and economic development. It is a connector: it underpins and flows through all the Sustainable Development Goals (SDGs). It is also integral for climate change mitigation, adaptation and resilience.

Rising water demands

Global freshwater use has been increasing at a rate of approximately 1% per annum since the 1980s (UNESCO, 2021). The rate of increase has tapered off in many OECD states, but is continuing to grow in middle and lower-income countries (UNESCO, 2021). Rising water demands are driven by population growth and the accompanying rising demands for food and energy, economic development and shifting consumption patterns (UNESCO, 2021). If global water use continues to rise at 1% per annum, it will result in an increase of 20-30% above current levels by 2050 (UNESCO, 2021; Molnar et al., 2017). Future economies may have higher water demands for a number of reasons, however, current water use is often quite inefficient, and some scenarios that assume increasing efficiency can show stable or even decreasing water consumption (Ligtvoet et al., 2017).

Agriculture is the world's largest water user, however, it is likely to face increasing competition from growing water demands from industry, energy, municipal and domestic users (UNESCO, 2021). Approximately 69% of all freshwater withdrawals are for agriculture (mainly for irrigation, but also for livestock and aquaculture) (UNESCO, 2021). Food production has increased by more than 100% in the past three decades (EIU, 2020). Water withdrawals for irrigation are the primary driver of groundwater depletion (UNESCO, 2021). The dominant drivers of water demand are water-intensive agriculture, expansion of water-intensive industry and inefficient irrigation practices (EIU, 2020). Industry, including energy production accounts for 19% of all freshwater withdrawals; whilst municipalities account for the remaining 12% (UNESCO, 2021).

Future agricultural water demand is difficult to predict and could be constrained by increasing demands from other sectors. FAO estimates that based on business-as-usual scenario, the world will need 60% more food by 2050 with irrigated food production increasing by more than 50% by 2050 (UNESCO, 2021). However, FAO also estimates that agricultural water withdrawals can only increase by 10% in this period (UNESCO, 2021). Solutions include improving water use efficiency in irrigation, improvements in rainfed systems, eliminating food waste, and shifting consumption towards less water-demanding diets (UNESCO, 2021).

Water availability, stress and scarcity

Water stress and scarcity are increasing. Estimates suggest (UNESCO, 2021):

- Over two billion people live in countries experiencing water stress: physical water stress is often a seasonal not annual phenomenon;
- Estimated four billion people live in areas that suffer from severe physical water scarcity for at least one month per year;
- Approximately 1.6 billion people will face 'economic' water scarcity: water is physically available, but they lack the necessary infrastructure to access that water.

Water withdrawal rates have risen almost six-fold over the past century (EIU, 2020) driven by factors such as population growth and changing consumption patterns amongst others. By 2014, the average global availability of renewable freshwater had dwindled to less than 6,000 cubic metres per person per year- a decrease of around 40% since the 1970s (EIU, 2020).

Climate change is increasing variability and unpredictability in water availability increasing the intensity and frequency of droughts and floods, and contributing to scarcity (Gleick et al., 2020). Climate change is projected to increase seasonal variability, creating a more erratic and uncertain water supply (UNESCO, 2021). This could exacerbate problems in already water-stressed areas and potentially generate water stress in places where it has not been a recurring phenomenon (UNESCO, 2021).

Scarcity is not simply biophysical, but social. Water stress is water use as a function of available supply (UNESCO, 2021). How people, communities and countries use and manage water is not simply a technical matter but a political one and the outcome of decision-making, regulation processes and influenced by political economy factors, as well as social factors and behaviours. In the Middle East and North Africa (MENA), increasing consumption, paired with undervalued water, unmanaged trade-offs in the water, food and energy nexus, inadequate governance arrangements, and weak enforcement is leading to the depletion of water resources— especially groundwater—at an unprecedented rate (World Bank, 2018). Writing of Pakistan, Mustafa et al. (2017) argue that **whilst material shortage contributes to water conflicts, they are fundamentally an outcome of human institutions and politics.**

Water quality

Water quality is an ‘invisible crisis’ (Damania et al., 2019). Poor water quality is a problem in both developed and developing countries and threatens human health, food security, and economic growth amongst other aspects (Damania et al., 2019). Water quality has deteriorated as a result of pollution in nearly all major rivers in Africa, Asia and Latin America (UNESCO, 2021). Nutrient loading is among the most prevalent sources of pollution (UNESCO, 2021). One of the biggest water quality challenges globally is managing excess nutrients in agricultural run-off (UNESCO, 2021). An estimated 80% of all industrial and municipal wastewater is released untreated into the environment-impacts human health and ecosystems: this figure may be higher in least developed countries (UNESCO, 2021).

Interactions between water and conflict

Water insecurity is increasing. Drivers include population growth, economic development, high and growing agricultural demand, increasing pollution, upstream infrastructure development, poor water resources management, and weak institutions (Gleick et al., 2020). The relationship between human security and water and climate-related stressors is fairly straightforward, for example, floods and droughts can lead to reduced food availability affecting human security (Ligtvoet et al., 2017).

Water insecurity can compound existing fragilities in social, economic and environmental systems, and combine with other societal stressors: this could make water conflict more likely or trigger migration (Sadoff et al., 2017; Geleick et al., 2020; Petersen-Perlman et al., 2017). Gleick et al., (2020) argue that water-related factors have contributed to political

instability, human dislocation and migration, agriculture and food insecurity, and violence (Gleick et al., 2020). Water resources are under increasing pressure, due to the intensification of the factors mentioned above, which is increasing water risks by undermining water access and water quality (Gleick et al., 2020).

There is some evidence that the risks and incidence of water-related conflict and political instability are on the rise (Gleick et al., 2020; OCHA, 2018; Ligtvoet et al., 2017):

- Water as a trigger for conflict (where control or access to water or water systems triggers conflict) rose from 27 events around the world in 2013, to 71 events in 2017;
- There have been 119 water-related conflicts globally between 1944 and 2016, ranging from tensions and riots to armed conflict.
- Political tensions are rising in some transboundary basins, for example, the Nile, the Mekong and the Indus, Ganges, Brahma Putra systems;

Narratives linking water, climate change and conflict argue that increased water insecurity affects conflict risks at the local, national, and international river basin levels (see for example, Ligtvoet et al., 2017). Water scarcity is often identified as the most important **water risk** for political tensions and conflict, based on deterministic assumptions drawing on Malthusian thinking linking environmental scarcity, resource competition and conflict, particularly at the national and sub-national levels. For example, population increases lead to increased water demands, driving shortages and reducing per capita availability: states are unable to meet growing demands for water, resulting in conflict (Tal, 2017).

Despite the intuitive logic of these narratives, the relationship between water, climate change and conflict is not deterministic or linear, nor is water a direct cause of conflict.

Factors, such as prior relations between different groups, the role of governments and institutions, and adaptive capacity influence whether or not natural resources become a source of competition, tension or conflict (see for example, Tubi & Feitelson, 2016; Selby & Hoffman, 2012).

The risk of competition, tensions and conflict may be more likely if water challenges intersect with other factors such as ethnic tensions, pre-existing fault-lines (e.g. pastoralists and farmers) and under-development (populations in least developed countries are more likely to be dependent on natural resources and governments are less likely to have the capacity to meet citizen's needs). Factors can compound each other: high population growth is occurring in the Middle East and Africa (MENA)²: areas which are also suffering from acute water shortages. However, a focus solely on per capita availability and measures of water stress and scarcity can mask some of the realities of water use and availability in the region (e.g. virtual water and its role in MENA's food security).

² <https://www.weforum.org/agenda/2018/05/why-the-world-s-fastest-growing-populations-are-in-the-middle-east-and-africa/>

Interactions between water, climate change and conflict

Climate change is projected to contribute to water insecurity and some argue could be a threat multiplier. Gleick et al. (2020) argue that:

- Water insecurity is increasing with challenges including water stress and scarcity, increased floods and droughts, and a lack of access to affordable WASH;
- Climate change is making these challenges worse;
- These challenges lead to increased insecurity, migration and a growing risk of conflict, especially in developing countries that lack financial, governance and technical capacities to deal with these problems.

Molnar et al. (2017) agree that as competition over water increases between sectors, countries and regions, due to different drivers including climate change, there is potential for conflict at all scales.

Climate change may multiply other stressors including food, energy and water demands, environmental degradation, and urbanisation, straining countries' abilities to meet their citizens' needs (Ruttinger et al., 2015). In weak states, climate change interacting with other stressors could overburden the state, spur social upheaval and sometimes violent conflict: even stable states are at risk of instability if the pressure is high enough or the shock is too great (Ruttinger et al., 2015). Acknowledging the extreme complexity and importance of context, the compound climate-fragility risks that emerge when climate change and other stressors interact and that could threaten state stability include (Ruttinger et al., 2015):

- **Local resource competition:** in the absence of effective dispute resolution mechanisms, increased local resource competition could lead to instability and conflict, potentially triggering problems at the national and international levels. Resource competition may be more disruptive in areas that rely on a narrow resource base, have a history of conflict or are home to marginalised groups. Equitable and effective natural resource management can reduce risk of conflict.
- **Livelihood insecurity and migration:** environmental changes due to climate change can combine with other problems such as insecure land tenure, unequal land distribution, poorly developed markets, trade barriers and inadequate infrastructure to drive migration. Climate change may also alter migration patterns and the number of people who migrate. If migration and resettlement are poorly managed, this could lead to local and regional instability.
- **Extreme weather events and disasters:** endanger and destroy lives, livelihoods, assets, health and community. In fragile and conflict-affected states, they can be mutually reinforcing: disasters put additional stress on weak governance systems, decrease economic opportunities, reduce resources, and displace people. In contexts that lack safety nets, preparedness, insurance and other mechanism to cope with disasters, their impacts can fuel grievances, especially if government or international assistance is inadequate or inequitably distributed. Disaster risk reduction and effective disaster management efforts can provide opportunities to improve resilience to climate-fragility risks and build peace.

- **Volatile food prices and provision:** climate change impacts are likely to disrupt food production in many regions, increasing prices and market volatility. High prices and price volatility caused riots in more than 40 countries between 2007-09. However, the likelihood that food insecurity contributes to instability depends not only on local factors, such as the degree of urbanization and market access, but also national policies, such as consumer subsidies and export markets.
- **Transboundary water management:** climate change impacts on water availability and quality in a context of growing water demands may increase pressure on existing governance structures, particularly in basins located in regions with a history of interstate tensions and conflict. Managing tensions over transboundary water use may be particularly complicated in transboundary basins affected by fragility or conflict as water management may be eclipsed by political considerations or affected by power asymmetries.
- **Sea level rise and coastal degradation:** threaten the viability of low-lying areas, leading to social disruption, displacement and migration. Potential for disagreements over maritime boundaries and ocean resources to increase.
- **Unintended effects of climate policies:** this may be a particular problem in fragile and contexts. Unintended consequences could include increased insecurity of land tenure, marginalisation of minority groups, increased environmental degradation and loss of biodiversity, and accelerated climate change. These unforeseen effects often arise due to the lack of cross-sectoral coordination and, in the case of fragile and conflict-affected situations, the lack of conflict-sensitive implementation of policies and programmes.

However, establishing direct causal links between water, climate change and conflict is challenging and contested. For example, a climate-induced drought in Syria between 2007 and 2010 was a factor in widespread crop failure, which was one driver of mass migration of farming families to urban centres (Kelley et al., 2015). This mass migration exacerbated a number of factors that contributed to unrest, leading eventually to civil war. However, rural communities' vulnerability to drought was increased by government agricultural policies, which led to groundwater exploitation in rural areas (Kelley et al., 2015).

The relationships between water, climate and conflict and instability/conflict are complex and depend strongly on political, economic, societal and cultural contexts (Ligtvoet et al., 2017). It is also important to distinguish between the international level, and the intra-country and local levels. At the international level there is a strong record of cooperation over international rivers, including between countries who have fought wars over other issues (e.g. India and Pakistan). However, at the intra-country and local levels there are a number of examples of water-related violence between different ethnic groups, water use sectors and provinces (Wolf, 2003). Although, OCHA (2018) argue that climate change and population growth are testing old understandings and norms of cooperation around water.

Climate mitigation policies may also aggravate water stress and competition (Ligtvoet et al., 2017). For example, increasing the use of hydropower could lead to local conflicts due to involuntary displacement and ecological issues, or cause tensions at the transboundary level; increased production of biomass could lead to intensifying competition for land and water for food production (Ligtvoet et al., 2017).

3. Transboundary waters, conflict, and climate change

Transboundary waters- conflict and cooperation

Transboundary rivers and aquifers are important shared water resources³. There are 286 transboundary (or international) river and lake basins, spanning 148 countries, and approximately 350 transboundary aquifers across the globe (Molnar et al., 2017; EIU, 2020). Transboundary river basins provide 60% of the world's freshwater flow and are home to 40% of the world's population. These basins are essential for agriculture, industry, energy generation, and domestic drinking water and sanitation (EIU, 2020). The world's 300 transboundary aquifers serve 2 billion people.

Management arrangements for transboundary waters vary (EIU, 2020):

- Only 84 river basins have joint water management bodies: their institutional capacity varies considerably.
- Only 9 of the 350 aquifers have permanent joint management mechanisms.

EIU (2020) argue that a lack of cooperation and equitable management can lead to conflict between or within countries, citing the examples of Darfur, Somalia, Iraq, Syria, the US, Bolivia and India.

Water is often securitised (considered part of national security) and related to countries' ideas of sovereignty. Examples of basins where water is securitised include: the Tigris-Euphrates (Turkey, Syria and Iraq); the Jordan, Yarmouk and Litani Rivers, and the West Bank aquifer (Israel, Jordan, Syria, Lebanon and West Bank Palestinians); the Nile (Egypt, Ethiopia and Sudan); the Indus; and, the Mekong (Cambodia, Laos, Thailand and Vietnam) (Molnar et al., 2017).

It is important to note that in some situations water may be used strategically with water linked to other issues: it can be the medium or vehicle through which countries express tensions. For example, in the wider dispute between India and Pakistan over the Kashmir region, water has been weaponised, with dam construction on the Ravi River being used by the Indian government as a reprisal for supposed Pakistani aggression in the contested territory (EIU, 2020). Tensions in political or economic relations can also shape relations among states over water (Molnar et al., 2017).

The record of acute conflict over international waters is overwhelmed by the record of cooperation (Wolf et al., 2003). Narratives of water wars, popular since the 1980s, argue that the importance countries attach to water, combined with increasing pressures on water and differing agendas for how shared waters should be used and developed, will lead to conflict between countries. However, the seminal Basins at Risk study undertaken by Wolf et al. (2003) analysed 1800 events involving water cooperation between nations from 1948-2000, ranking them on a scale from -7 (formal declaration of war) to +7 (voluntary unification into one nation). **Cooperative events outweighed conflictual ones by 2 to 1** (Wolf et al., 2003). Conflictual

³ This section restricts discussion of transboundary waters to those shared between different countries as opposed to waters that are cross-jurisdictional within countries.

events commonly did not involve violence or war (Wolf et al., 2003). **In contrast to the low number of severe water disputes that have occurred globally, 295 water cooperation treaties have been signed** (Molnar et al., 2017).

Conflicts are likely to be experienced in terms of verbal or economic acts, not violent acts (Petersen-Perlman et al., 2017). Traditionally water has not been viewed as causing, or being the sole cause of violent conflict at the international level, although there are examples of violent conflict events (e.g. shots fired, troops mobilised etc.) (Petersen-Perlman et al., 2017). De Stefano et al. (2010) identified 38 acute disputes (ones involving water-related violence) between 1948 and 2008. Of these 31 were between Israel and one or more of its neighbours prior to 1970. The majority of events identified by De Stefano et al. (2010) were political tensions or water as a casualty of war.

Water infrastructure development as a source of tension

Development of new water infrastructure can lead to stress, tensions and potential disputes due to changes to the hydrological functions of the basin and cross-border impacts. An estimated 1416 new large dams and water diversions were ongoing or planned in at least 57 basins worldwide according to Stefano et al. (2017). This includes over 100 dams proposed, planned or under construction in both the Nepal and India parts of the Ganges-Brahmaputra-Meghna (GBM) basin (Stefano et al., 2017). Five countries share the GBM (Bangladesh, Bhutan, China, India and Nepal. China also has dam-building plans on the Brahmaputra River. Stefano et al. (2017) found that Asia has the highest number of proposed, planned and under construction dams in transboundary basins (807), followed by South America (354), Europe (148), Africa (99) and North America (5). Hotspots in Africa include Ethiopia, Lake Chad, and South Sudan (Stefano et al., 2017).

A key source of tensions between countries sharing a basin is unilateral action related to dam construction or river diversion, particularly in the absence of transboundary institutions (Wolf, 2009; Stefano et al., 2017). Past research suggests that the most indicative variables for conflict reflect rapid or extreme change to physical or institutional systems within a basin in the absence of transboundary institutional mechanisms able to manage the effects of that change (Stefano et al., 2017)⁴. The construction of large dams by upstream riparian countries without an agreement in place is one of the strongest indicators of a basin's potential hydro-political tensions (Stefano et al., 2017). However, the likelihood of tensions is usually increased by a set of converging and exacerbating factors (Stefano et al., 2017).

Factors influencing the future potential for conflict or cooperation

A range of factors may increase the potential for conflict in the future. These include rising water demand in international basins due to population growth and other factors, coupled with increasing variability, due to climate change, and rapid changes due to human, economic and socio-ecological factors (Petersen-Perlman et al., 2017).

⁴ Other factors that have been suggested by the Asian Development Bank as potentially contributing to increased tensions between riparian countries are: high population growth, urbanisation, increasing water pollution, over-abstraction of groundwater, climate change and water-related disasters (ADB, 2013).

Countries' responses to these challenges could increase the potential for conflict. For example, infrastructure construction that could affect the flow regime or water quality with economic consequences (Petersen-Perlman et al., 2017; Molnar et al., 2017). Tensions between Uzbekistan and Tajikistan over the latter's dam-building centre on the potential negative impacts on the former's cotton industry (Petersen-Perlman et al., 2017).

Whether conflict increases or decreases, however, depends on several factors (Petersen-Perlman et al., 2017). Shared interests, institutional capacity and other factors seem to ameliorate water's conflict-inducing characteristics at the international level (Wolf et al., 2003). Cooperative water regimes, including basin treaties, are often resilient even amongst otherwise hostile riparian nations such as the Indus Water Treaty between India and Pakistan.

Institutions such as international water treaties and river basin organisations can mitigate some of the tensions/potential disputes (De Stefano et al., 2017). These institutions provide opportunities for dialogue between riparian countries; they can also provide access to conflict resolution mechanisms. For example, Argentina and Uruguay are parties to the 1975 River Uruguay Treaty. In 2006, Argentina instituted proceedings against Uruguay at the International Court of Justice over its construction of two pulp mills on the mainstream (Rieu-Clarke, 2015). The Indus Waters Treaty also allows for disputes resolution, with disputes resolved in the past by state level talks, a Neutral Expert and by the Permanent Court of Arbitration (Raman, 2017). Inclusion of mechanisms such as flow variability or data sharing provisions can reduce uncertainty and increase flexibility, boosting the overall adaptive capacity of the basin (sources quoted in De Stefano et al., 2017).

Identifying basins at risk

By focusing on the relationship between rapid change (biophysical or geopolitical) and the institutional capacity to absorb that change, De Stefano et al. (2017) identify basins at risk in the next 5-10 years⁵. This includes basins in Southeast Asia, South Asia, Central America, the northern part of the South American continent, the southern Balkans as well as in different parts of Africa. Basins at risks are identified as those where new water infrastructure is being built or planned and formal transboundary arrangements are absent, and there is a concomitance of political, environmental and socioeconomic factors that could exacerbate hydropolitical tensions (De Stefano et al., 2017). These factors are: high or increased climate-driven water variability; recent depletions in water reserves; presence of armed conflict within a state; presence of armed conflict between states; recent unfriendly interactions over water; and, low gross income per capita (De Stefano et al., 2017). However, it is important to note that whilst these factors were selected for inclusion in De Stefano et al.'s (2017) study, other factors such as competition among water users, degradation of water quality and adaptive capacity may also potentially impact hydropolitical relationships. **Whilst climate change could exacerbate tensions due to its impacts on water variability and scarcity, other factors are more likely to determine whether violent conflict arises** (De Stefano et al., 2017).

⁵ Stefano et al. (2017) define conflict, tensions and disputes as "conflictual interactions between states that may range from mutual accusations and diplomatic tensions all the way to what popular quantitative datasets define as militarized interstate disputes".

Tools, mechanisms and solutions

Institutions

Reliance on transboundary waters is growing, which creates an urgent unmet need to manage them in a sustainable, equitable and collaborative manner (EIU, 2020). The river-basin scale remains key to reducing transboundary tensions, organising joint fact-finding processes and building cooperation between communities and countries (Ligvoet et al., 2017).

The proportion of transboundary basin with an operational arrangement for water cooperation is one of the indicators for SDG 6. Institutional capacity in a basin is generally bolstered by effective river basin organisations (RBOs), resilient treaties, and generally strong geopolitical relations (Stefano et al., 2017).

Institutions such as water sharing agreements and treaties, or informal working relationships, and building institutional capacity are the strongest methods to prevent and resolve water conflicts (Petersen-Perlman et al., 2017). How water is governed or managed is extremely important in terms of mitigating or amplifying the potential for conflict. International water conflicts may happen when there is no institution that delineates each nation's rights and responsibilities with regard to the shared body of water, nor any agreements or implicit cooperative arrangements (Petersen-Perlman et al., 2017).

The key role that water institutions can play in mitigating tensions between riparian countries, highlights that institutional resilience should be an area of interest, particularly the question of whether they can adapt to changes in the basin. There is some evidence to suggest that once agreed treaties between countries can prove resilient. For example, the Indus Water Treaty between India and Pakistan has survived two wars between its parties; whilst the parties to the Mekong Committee (the Mekong River Commission's predecessor) continued to meet during the Vietnam War, despite Thailand being on the opposing side to its neighbours.

The presence of a treaty does not also mean that a basin is effectively managed, or that treaties are substantive or enforced: treaties and RBOs do not in themselves ensure cooperation (sources in De Stefano et al., 2017). Characteristics that can improve treaty effectiveness include flexible management structure, clear and flexible allocating criteria, equitable distribution of benefits, detailed conflict resolution mechanisms; mechanisms for increasing resilience towards water variability (e.g. flexible but specific water allocation mechanisms); treaties that include a direct enforcement measure, an adaptability mechanism, and a self-enforcement clause present higher levels of cooperation relative to those that do not have such provisions (sources in De Stefano et al., 2017).

Water sharing agreements and treaties are products of their time and do not reflect changing conditions, such as climate change, population growth or levels of development. For example, Pohl et al. (2014) argue that the Indus Waters Treaty cannot address the current challenges the Basin is facing and does not provide the necessary instruments for adapting to growing scarcity.

They can also reflect power asymmetries in a basin. Zeitoun et al.'s (2019) analysis of two agreements on the Yarmouk tributary to the Jordan River found that both a 1987 agreement

between Jordan and Syria, and a 1994 agreement between Jordan and Israel reflect the power asymmetries between the countries. Both agreements are 'blind' to existing use, incapable of dealing with urgent governance needs, and impede more equitable arrangements (Zeitoun et al., 2019). They also lack important clauses that could govern groundwater abstraction, environmental concerns, water quality, and the ability to adapt to changing water quality, availability and need; and, include both ambiguous and rigid clauses that result in generally inequitable allocation of water and thus of the benefits derived from its use (Zeitoun et al., 2019).

Power asymmetries exist in transboundary basins, and influence the nature of both water cooperation and conflict. Zeitoun & Warner (2006) argue that power relations between riparian countries are the prime determinants of the degree of control over water resources that each riparian attains. The interests and engagement of basin hegemon (the superior power in the basin who sets the "rules of the game") can limit productive and equitable transboundary water management (Zeitoun & Jagerskog, 2011). Hydro-hegemon may choose to enforce either a negative form of dominance or a positive form of hydro-hegemonic leadership, with this choice influenced by the actions of non-hegemon, and also larger political processes (Zeitoun & Warner, 2006).

It is also important to note that transboundary water interaction is inherently political (Zeitoun & Mirumachi, 2008). Conflict and cooperation also co-exist, for example, riparian countries may cooperate in terms of data sharing over water, whilst being engaged in a dispute in other areas (Zeitoun & Mirumachi, 2008).

International water law

Treaties and water-sharing agreements are often guided by principles and norms of international water law first outlined in the 1966 Helsinki Rules on the Uses of the Waters of International Rivers (Molnar et al., 2017). For example, prior notification, the duty to notify co-riparian countries of certain types of uses, appears in a number of transboundary river basin treaties, including the 1995 Mekong Agreement. However, application of this duty is often problematic (see for example, the case lower Mekong mainstream hydropower dam development; Rieu-Clarke, 2015). The 1997 UN Watercourses Convention came into force in 2014 and seeks to codify customary international water law (McCaffrey, 2014). Its key principles include equitable and reasonable utilisation, no reasonable harm, and prior notification (UN, 1997).

Third Party involvement and Water diplomacy

A number of actors have engaged in third party involvement in the management of international river basins or in water diplomacy to defuse tensions and/or support the establishment of a water sharing agreement. For example, (Petersen-Perlman et al., 2017):

- the World Bank is a co-signatory to the Indus Water Treaty and plays a role in third party mediation of disputes;
- the East African Community, through the Lake Victoria Basin Commission, helped Kenya and Tanzania sign a MoU on management of the Mara River;

- the World Bank helped Albania and Macedonia to develop and sign a MoU on the Lake Ohrid watershed, which had been without any diplomatic contact for decades due to historical political circumstances.

Treaties and other efforts towards transboundary cooperation can be more resilient to conflicts through the involvement of third parties (Petersen-Perlman et al., 2017).

Water diplomacy is the use of diplomatic instruments to existing or emerging disagreements and conflicts over shared water resources with the aim to solve or mitigate those for the sake of cooperation, regional stability, and peace (Schmeier, 2018). As such it uses diplomatic instruments such as negotiations, dispute-resolution mechanisms, the establishment of consultation platforms and organisation of fact-finding missions (Schmeier, 2018). Water diplomacy uses water as a means to contribute to broader goals of peace and stability through diplomatic engagement and cooperation. It can involve both state and non-state actors as third parties (as above) (Molnar et al., 2018). Cooperation over water can extend to other areas beyond water such as international relations aiming at promoting good relations, peace, security and prosperity, by having impact on food security, or economic stability, improved regional security and integration, better trade relations and power sharing pools (Molnar et al., 2017).

Water diplomacy is distinct from water cooperation and transboundary water management (Schmeier, 2018). Transboundary water management applies technical tools to specific water-related challenges e.g. monitoring certain parameters as a basis for implementing water quality measures (Schmeier, 2018). Water cooperation ensures that the benefits from managing water resources cooperatively rather than unilaterally are generated for riparian parties (Schmeier, 2018).

However, the three concepts are connected. For example, the Mekong River Commission has transboundary water management instruments (e.g. data collection, flow monitoring and modelling are used for flood forecasting and warning); water cooperation elements (the Basin Development Strategy); and, water diplomacy (e.g. mechanisms such as prior notification and governance meetings to manage negotiations over disputes) (Schmeier, 2018).

Water diplomacy can be preventive (Schmeier, 2018). For example, it can be used to address issues such as different conceptions of how a shared river should be developed before they turn into conflicts (Schmeier, 2018). As a preventive tool it can support trust-building, providing a platform for joint studies and collaborative risk assessments by riparian countries (Molnar et al., 2017).

Blue Peace

Blue Peace “refers to water cooperation across borders to foster stability and sustainable development” (EIU, 2020). This can be in the form of shared institutions and legal frameworks which bring countries together in a commitment to resolve differences peacefully –and to use their shared water as a foundation for wider economic and diplomatic collaboration (EIU, 2020). Blue Peace is ‘positive-sum’: countries enjoy more benefits from working together than they would separately, with benefits including enhanced energy security, protected biodiversity, reduced flooding and drought, and optimisation of investments (EIU, 2020). **Using a range of**

diplomatic, political, technical and financial tools can transform water from a source of dispute to an instrument of cooperation (EIU, 2020).

Blue Peace can be promoted in a number of ways (EIU, 2020):

- **Political will/Moving water to the top of the political agenda:** engagement is needed from government entities outside of the water, environment and agriculture sector. Linking water to a wider range of policy goals, and integrating water diplomacy into regional and bilateral political dialogues can help identify new ways forward when shared benefits are not initially evident. Commitment to joint benefit-sharing can yield various economic, environmental, and political benefits.
- **Stronger institutions:** external financial and technical support can play a critical role in the creation and early-stage development of water cooperation institutions, particularly in politically and diplomatically sensitive contexts.
- **Developing trust:** small-scale technical cooperation can help to steadily build trust that allows countries to work through difficulties, whilst joint identification and assessment of shared benefits can help facilitate cooperation even under challenging circumstances.
- **Inclusive decision-making:** water management practices need to balance the needs of different communities. Inclusive and participatory decision-making can balance interests and secure sustained support and collaboration from diverse communities.
- **Evidence-based decision-making:** data, modelling and evidence is needed to ensure riparian communities can respond effectively to emerging challenges; it can also facilitate dialogue and collaboration, for example, highlighting the economic and well-being costs of cooperation failures that lead to flooding or drought.
- **Finance:** finance is a critical enabler or obstacle to Blue Peace. Finance for transboundary projects, especially when the aim is preservation not development/economic returns, is difficult to access. Channelling more finance will require improved coordination between donors, more attractive and stable national investment landscapes, as well as a better environment for sustainable public-private partnerships, innovative new financial mechanisms such as Blue Peace Bonds, and a greater role for the impact investment community.

Benefit sharing

Benefit sharing seeks to shift water in transboundary basins from being seen as a ‘zero-sum’ game to a ‘positive-sum’ game. Tensions over shared waters can be rooted in zero-sum thinking: ‘more water for you means less for me’. Whilst it is important to note that countries will always have a national agenda when it comes to water (Sadoff & Grey, 2005), focusing on the benefits that can be derived from cooperation can deliver ‘positive sum’ outcomes. Cooperation can be viewed as a continuum, from simple information sharing through to joint ownership and management of infrastructure investments (Sadoff & Grey, 2005).

A range of cooperative benefits can be derived from international rivers by riparian countries. Sadoff & Grey (2002) categorise four types of benefits:

- **Benefits to the river:** cooperation enables better management of ecosystems;

- **Benefits from the river:** efficient cooperative management and development of shared rivers can yield major benefits such as increased food or energy production;
- **Reduction of costs because of the river:** tensions between co-riparians generate costs, cooperation may reduce those costs.
- **Beyond the river:** international rivers can be catalytic agents and cooperation that yields benefits from the river and reduces costs can pave the way to greater cooperation between the states.

The extent and relative importance of these types of benefits will vary greatly between basins due to different circumstances and context (Sadoff & Grey, 2002). For example, the Colombia River Treaty allows for cooperative management of a dam cascade to provide hydropower generation and flood control benefits for the USA and Canada (Schmeier, 2018).

Senegal River Basin countries have led the way in innovative forms of shared ownership and governance, representing a “unique case of substantive transboundary cooperation on the management of water infrastructure” (Tignino, 2016). The first agreement was signed in 1963 between the four riparian countries (Guinea, Mali, Mauritania and Senegal). The Senegal River Development Organisation (OMVS) was established in 1972 (although Guinea did not accede until 2006). The Diama and Manantali Dams are jointly owned, managed and financed through the OMVS under its provisions for common works, with two agreements in 1997 established separate, autonomous agencies responsible for the management and operation of the two dams (Tignino, 2016). The OMVS members act as co-guarantors for the repayment of any loans extended to the organization for the construction or operation of jointly managed facilities (Tignino, 2016). The two dams provide a number of benefits including energy, drinking water provision, irrigation, flood control and prevention of saltwater intrusion. The OMVS acted as a vehicle for mobilising finance from the international community for the projects and the countries negotiated a cost-sharing schedule for repayment which allocated costs based on expected benefits (Tignino, 2016).

4. Intra-country water conflict and climate change

Whilst at the transboundary level, countries normally settle water disputes peacefully, within countries, water-related conflict appears to be increasing (OCHA, 2018). Wolf et al. (2003) argues that there is a history of water-related violence at the sub-national level between different ethnic groups, water use sectors and provinces, amongst others.

There are a number of examples of intra-national water conflicts (of varying severity) between provinces or states within a country over water allocations, infrastructure development and water quality:

- In India, protesters rioted in 2016 in Bengaluru after the Supreme Court ordered the state of Karnataka to release more water to downstream Tamil Nadu; and, in 2017, political conflict between the states of Madhya Pradesh and Gujarat over sharing of water from the Narmada River was accompanied by deadly protests in Madhya Pradesh over insecure farm incomes made worse by drought (Gleick et al., 2020).
- In Pakistan, non-provincial areas such as Gilit-Baltistan and Islamabad were not allocated water under the 1991 Inter-Provincial Water Accord. Growing water scarcity has prompted leaders to start demanding a share of the Indus waters (Swain, 2017). There are long-standing water tensions between the provinces of Punjab and Sindh over

water allocations, the operation of the Chashma-Jhelum Link Canal, and the proposed Kalabagh Dam (Mustafa et al., 2017).

- In Iran, there have been violent internal protests over water diversions between provinces. Severe droughts and internal water diversions from one region to another have contributed to fluctuations in the levels of Lake Urmia (Gleick et al., 2020).

Water conflict at the local level often revolves around infrastructure development, water quality, water pricing and access. Examples include:

- The ongoing Teesta River campaign which aims to stop a planned hydropower dam being built on the last-free flowing stretch on the river in Sikkim, India⁶;
- Oil pollution in Nigeria's Niger Delta has harmed community water resources and is linked to conflict in the local community (Babatunde, 2020);
- The Cochamba Water War, a series of protests in the Bolivian city in 1999-2000 following privatisation of the water company (and perhaps the most famous example of a water pricing dispute).
- In Egypt in April 2018, farmers in the Nile Delta held demonstrations after the government imposed a sudden ban on water-intensive irrigated rice crops; local perceptions in Lebanon's Bekka Valley link Syrian refugees with tensions around scarce water resources (Schaar, 2019; UNDP, 2018).
- As part of the response to Chennai's (India) 'Day Zero' crisis water was diverted from poor, rural farmers outside of the city by private tankers to service demand in the city⁷.

Protests in India in 2016-2019 related to water illustrate the interplay between local and inter-state/province water issues and how **a multiplicity of drivers of water risk interact at these levels, including physical, social, economic and political factors**. Drivers of water risk in this context included: chronic water stress throughout much of the country (water demands are too high relative to available supply); very pronounced seasonal variability in rainfall, making the country highly vulnerable to failures of the monsoons; large population and high population growth; inefficient water use in agriculture; food loss and waste; high vulnerability associated with extreme poverty; poor water governance and conflicts between national and state-based policies (Gleick et al., 2020).

Relations over water at the intra-national and local level can be impacted by actions at the international level- further emphasising the complexity and interconnectedness of these issues. For example, Turkey's dam building in the headwaters of the Tigris and Euphrates has reduced water flow into Iraq and Syria. Thai villagers have petitioned a court in Bangkok to slow Thai purchases from the Thai-financed Xayaburi Dam in Laos on the basis that it has harmed their livelihoods⁸. In the Hirmand/Helmand River basin shared by Iran and Afghanistan, communities have reported violence over water allocations and use (Gleick et al., 2020).

⁶ For more information see <https://www.internationalrivers.org/news/teesta-river-campaign-mingma/>

⁷ For more information see <https://www.wri.org/insights/responding-day-zero-equitably-water-crisis-lessons-cape-town-and-chennai>

⁸ For more information see: <https://www.reuters.com/article/us-mekong-river-thailand-idUSKBN2081VN>

Drivers and pathways of water-related risk

There are a number of potential pathways connecting water insecurity, climate change and conflict. A number of leading organisations such as UNDP and scholars have linked water and climate change impacts with social unrest in the Middle East and North Africa, including the 2008 food crisis in Egypt (Schaar, 2019; UNDP, 2018). Schaar (2019) speculates that in the MENA region a potential pathway could be climate change impacts communities already suffering water stress, increasing competition over water resources, and adding to existing tensions.

Water crises are contributing factors that can influence the risks of conflict and political instability, particularly when growing water insecurity combines with other societal stressors (Gleick et al., 2020). For example, severe water quality problems triggered social unrest and violent protests against the government in 2018 and 2019 in Southern Iraq (Gleick et al., 2020). Water quality problems were caused by: reduced flows in the Tigris and Euphrates, which allows saltwater intrusion from the Persian Gulf; and, untreated sewerage following into the rivers (Gleick et al., 2020).

Water can be a trigger and can exacerbate pre-existing tensions. For example, protests in Iraq in 2018 were related to lack of access to water and electricity, poor employment prospects and government corruption (Gleick et al., 2020). Drivers of water-related risk in Southern Iraq include population growth and growing water demand in the countries sharing the Tigris-Euphrates; new upstream infrastructure in Turkey, Iran and Syria; climate change and worsening drought; inefficient water use in agriculture and urban areas; poor governance and corruption; and, destruction of water infrastructure during war (Gleick et al., 2020).

Migration

Water related challenges may contribute to migration pressures and household decisions to migrate. For example, five years of drought in the Central American Dry Corridor (spans parts of Costa Rica, Nicaragua, Honduras, El Salvador, and Guatemala) has resulted in farmers migrating to regional cities or the USA (Gleick et al., 2020). In Iran, declining water availability in rural areas is undermining rural livelihoods and contributing to rural-urban migration (Gleick et al., 2020). Widespread crop failure in Syria due to drought between 2007-2010 was one driver of mass migration of farming families to urban centres (Kelley et al., 2015).

Whilst migration is multi-causal and migration choices are complex, there is emerging evidence from MENA that climate change impacts influence migration, for example, through its impacts on agriculture and the viability of rural livelihoods (Durrell, 2018). The region is also vulnerable to sea-level rises, which could lead to people migrating from coastal cities such as Alexandria, Egypt, as well as threatening water supplies and agriculture through saltwater intrusion. Coastal aquifers in Tunisia, Egypt and Israel are already suffering from saltwater intrusion due to over-extraction and reductions in recharge: sea level rises will aggravate saltwater intrusion, salinization of groundwater, rising water tables and impeded soil drainage (Waha et al., 2017). However, intervening variables will play an extremely strong role in determining whether environmental change leads to population movements.

Pastoralists and farmers

Increased farmer-herder violence (both in terms of frequency and intensity) in the Sahel has been linked to increased water scarcity, drought, access to water and pasture, climate change and environmental degradation (see for example, ICG 2018; Gleick et al., 2020).

Examples include (IGC, 2018; EIU, 2020, Gleick et al., 2020; Schaar, 2017):

- In Nigeria, 1800 people were killed between September 2017 and June 2018, although conflict has been worsening between farmers and herders since 2014;
- Ongoing dispute between Fulani herders and Dogon farmers on the Mali-Burkina Faso border. In 2012, an agreement which allowed Fulani herders to pass into Mali to access resources broke down resulting in deadly conflict. Sources cite drought and water scarcity as factors intensifying the tension between the two groups and triggering continued clashes.
- Violence between Fulani herders, Dogon and Bambara farmers and Bozo fishers in the Mopti region of Mali between 2019 and 2020 led to several hundred deaths. Violence in this region revolves around use of and access to water and land, resource sharing, and seasonal migration of livestock, but there is a growing ethnic and religious component. Failure to address violence in this region was of the factors that led to collapse of Mali's government and the resignation of the Prime Minister.
- Lake Chad: climate change has been identified as a security threat. Livelihoods and food security of those living around the lake are closely linked to its ecosystem and resources. The climate change and conflict dynamics in Lake Chad are extremely complex, but, include resource competition between herders, farmers and fishers (Vivekananda et al., 2019).

Drivers of increased conflict in the Sahel include climate-related, social and historical factors as well as governance failures and weak institutions: water exacerbates these factors and can trigger conflict. Changes in hydrology and climatology have pushed pastoralists further south at a time when traditional conflict-resolution mechanisms such as payment of compensation and local mediation have weakened and there is a growing religious extremism amongst the different groups (Gleick et al., 2020). As populations have grown settled communities have expanded; watering holes and lands formerly used by pastoralists have been appropriated; and crops have been damaged by cattle (Gleick et al., 2020).

Governance, institutions (including social norms) and government responses are strong intermediate variables in relation to water and climate change challenges. In Nigeria, whilst the conflict's roots lie in a number of areas including climate-induced environmental degradation in the North and insecurity due to Boko Haram driving migration, it was governance-related factors that led to the escalation in 2018 (IGC, 2018). Three immediate factors led to the escalation of violence in 2018: militia attacks, poor government response, and new laws banning open grazing in Benue and Taraba states. The new laws led to an influx of herders from the north following the anti-open grazing laws, migrating into areas where high population growth over the last four decades has increased pressure on land (IGC, 2018). Combined with this there has been a decline in traditional mediation mechanisms and in the absence of mutually agreed alternatives quarrels are increasingly turning violent (IGC, 2018).

The influence of environmental factors on conflict is contested. Ayana et al. (2016) argue that quantitative support for the hypothesis that environmental factors trigger conflicts amongst pastoralist communities in East Africa is lacking. Their evaluation of long-term trends in water scarcity and forage for livestock and conflict data found that environmental stressors were only partly predictive of conflict events (Ayana et al., 2016). Analysis of the effect of water scarcity on incidences of domestic water cooperation in the Mediterranean area and Northern Africa region from 1997 to 2009 found that (Doring, 2020):

- More difficult access to groundwater is found to increase the likelihood of water cooperation, both between non-state actors and between the government and other state or non-state actors;
- The relationship between water scarcity and non-state water cooperation is stronger in areas within less democratic countries, suggesting that in less democratic countries actors find solutions to water scarcity without the help of central government;
- Areas with armed conflict in the past year are more likely to witness incidences of state-initiated water cooperation.

Fragile states and water

In fragile and conflict-affected states, water challenges and fragility are often related. However, this does not mean there are direct causal linkages between water crises, social tensions and unrest, migration or other manifestations of fragility (Steduto et al., 2018). Drivers of fragility involve a range of factors that interact in complex and often unpredictable ways (Steduto et al., 2018).

Water crises can aggravate existing fragilities, whilst fragility also makes it harder to address water issues (Steduto et al., 2018). Water security is harder to achieve in fragile contexts due to factors such as weak institutions and information systems, strained human and fragile resources, and degraded infrastructure (Sadoff et al., 2017). Simultaneously, failure to achieve water security can be more damaging in fragile contexts as populations are particularly vulnerable to the direct impacts of water insecurity (Sadoff et al., 2017). Water-related challenges and crises can strain the ability of individuals and populations to maintain livelihood security (Steduto et al., 2018). This can intensify perceptions that the government is unwilling or unable to meet its citizens' needs and exacerbate existing grievances (Sadoff et al., 2017; Steduto et al., 2018). This can weaken the social compact between the government and citizens, acting as a destabilising force and a risk multiplier (Sadoff et al., 2017). **As such, water crises can compound socio-economic risks related to poor governance and marginalisation, and trigger social friction, unrest, migration and violent conflict** (Steduto et al., 2018).

Water insecurity and fragility interact through three mechanisms (Sadoff et al., 2017): failure to provide citizens with basic water services; failure to protect citizens from water-related disasters; and, failure to preserve surface, ground and transboundary water resources. **These failures can give rise to a vicious cycle of water insecurity and fragility** (Sadoff et al., 2017; Steduto et al., 2018):

- Factors related to fragility (e.g. weak and ineffective institutions, histories of conflict etc.) compound challenges related to sustainable water management such as access to WASH or water for livelihoods.

- Fragility makes it more difficult for water management to be effective, in turn amplifying these challenges.
- As water issues are left unaddressed, their impact increases, eroding government legitimacy and destabilising fragile contexts.
- Writing of the MENA region, Steduto et al. (2018) argues that in some parts of the region, water scarcity and governance challenges interact with situations of armed conflict and political instability to give rise to this vicious cycle

Institutions and policy choices mediate the impacts of water insecurity on people and economies, either reversing or perpetuating the vicious cycle that can exist between water insecurity and fragility (Sadoff et al., 2017; Steduto et al., 2018). Institutional failures to address water-related challenges can act as risk multipliers, compounding existing situations of fragility (Steduto et al., 2018). If policy design and implementation does not adequately promote sustainability and resilience, fragility risks can be amplified (Steduto et al., 2018).

However, improving water management can contribute to building resilience in the face of protracted crises, reversing the vicious cycle and promoting stability (Steduto et al., 2018). Delivery of basic services and access to sustainable water resources for communities can demonstrate a government's ability and willingness to meet its citizens' needs (Steduto et al., 2018). Rapid and equitable protection from water-related disasters can prevent water challenges from acting as risk multipliers and mitigating potential trigger events (Steduto et al., 2018). Writing of the MENA region, Steduto et al. (2018) argue that shared water management can support stabilisation, recovery and peacebuilding, whilst at the regional level, cooperation over shared water resources also offers an opportunity to promote peace and stability (Steduto et al., 2018).

Tools, mechanisms and solutions

Policy development processes are needed that can integrate water and climate aspects and explicitly account for them in development policies at the river basin, national and local levels (Ligvoet et al., 2017). Participation, particularly of local communities, in policy development will be important for reducing security and conflict risks as local social and cultural contexts are crucial factors (Ligvoet et al., 2017). Support for water management institutions in developing countries is also crucial: they often lack the human, technical and financial resources to develop and implement comprehensive management plans that can properly accomplish the installation of sufficient governing mechanisms (Petersen-Perlman et al., 2017).

Local dispute resolution

Conflict resolution practices are common in communal disputes across sub-Saharan Africa (Doring, 2020). Mechanisms that allow stakeholders to agree joint plans can help to defuse tensions. For example, in Kenya's Tana Delta drivers including population growth, climate change, deforestation and land degradation have contributed to inter-ethnic conflict and resource

competition (land and water) within and between communities (Odhengo et al., 2014)⁹. Anecdotal evidence suggests that 286 people died in 2012 in clashes between farmers and pastoralists. Policy and governance responses to increasing conflict in the Tana River Delta include the development of the Land Use Plan for the Tana River Delta through a process involving national and local stakeholders facilitated by a non-governmental organisation (NGO), Nature Kenya. Nature Kenya also worked with over 100 villages in the Delta to develop land-use plans and support better natural resource management. Odhengo et al. (2014) argue that land-use planning is a coordinated approach to the management and planning of Delta resources: sectoral planning tends to be single-resource focused.

Water, Peace and Security Partnership¹⁰

The Water, Peace and Security Partnership suggest four broad categories of solutions: natural resources, science and engineering approaches; political and legal tools; economic and financial tools; and policy and governance strategies (Gleick et al., 2020). The most appropriate solutions or combination of solutions will vary depending on the location and the risk factors at play, and will need to be adapted to varying social, economic, and political contexts (Gleick et al., 2020). For example, possible solutions to drivers of water-related risk in India include improving water-use efficiency in agriculture; increasing water storage; protecting ecosystems and establishing and implementing minimum river-flow commitments; establishing water-use limitations in high water-stress areas; establishing or strengthening interstate water-sharing agreements; and increasing water prices along with subsidies to protect the poor (Gleick et al., 2020).

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⁹ For more information see <https://www.unep.org/news-and-stories/story/balancing-climate-conflict-and-community-kenya>

¹⁰ The Water, Peace and Security partnership was founded in 2018 to develop innovative tools and services that help identify and address water-related security risks. It is a collaboration between the Netherlands Ministry of Foreign Affairs and a consortium of six partners lead by IHE Delft. For more information see <https://waterpeacesecurity.org/info/about-wps>

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