



THE ROLE OF WATER STRESS IN INSTABILITY AND CONFLICT



December 2017

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CNA
ANALYSIS & SOLUTIONS

Cover Image: Violent protest in Bolivia over government increases to the cost of water.

Recommended Citation:

CNA. 2017. *The Role of Water Stress in Instability and Conflict*. CRM-2017-U-016532. Final.

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THE ROLE OF WATER STRESS IN INSTABILITY AND CONFLICT

To the reader:

As senior military officers, we see water stress—the lack of adequate fresh water—as a growing factor in the world’s hot spots and conflict areas, many of vital interest to the United States. Our earlier reports have identified a nexus among climate, water, energy, and U.S. national security. We have previously shown how emerging resource scarcity across this nexus can be a threat multiplier and an accelerant of instability. **With escalating global population and the impact of a changing climate, we see the challenges of water stress rising with time.** It is in this context that we now seek to provide a better understanding of the mechanisms through which water factors into violence and conflict.

This report examines the role of water across a spectrum from civil unrest and localized violence to terrorism, insurgencies, and civil wars to state-on-state conflict. Focusing on water-stressed areas of the world, it articulates the role water plays not only in diplomacy, violence, and conflict, but also how water can be used as a tool of coercion across the spectrum of conflict. Additionally, the research provides insight into how water stress can **empower violent extremist organizations and place stable governments at risk.**

The report details how this pattern is repeating across much of Northern and Sub-Saharan Africa, the Middle East, South America, and other areas of the world where fresh water is no longer meeting the needs of burgeoning populations and urbanization. But the pattern is not limited to places where there are too many people and not enough rain. Water stress is caused by poor water management, dwindling aquifers, demographic changes that increase demand for more water-intensive food, and the growing use of water resources in energy production. In the future, climate change will add to these challenges the saltwater intrusion of aquifers, changing precipitation patterns, and dissipating glaciers.

This work reinforces our belief that that water has not yet been a cause of outright war. But it makes clear that water stress can be central to inciting violence below that threshold, especially in civil unrest—protests, strikes, and riots. **The risk that fragile or feckless governments will be unable or unwilling to respond rises as water stress grows, opening the door to escalation and even government destabilization. It is then that an isolated**

or localized event may threaten the national interests of the United States or its partners and allies.

This report represents a collaboration between the admirals and generals of the CNA MAB and CNA researchers, and we fully support the findings and recommendations as they pertain to our area of expertise, U.S. national security. It is our resolve that this research provide security experts with a better understanding of the means by which water stress contributes to conflict, including its use as a tool of influence or domination. We must better understand the relationship between water and conflict now to avoid more serious threats to our national security in the very near future.

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ACKNOWLEDGEMENTS

We are thankful to many for their support of this effort. We would like to thank those at CNA who offered their contributions, review, and sage counsel including: Dr. Kim Deal, Mr. Larry Ferguson II, Dr. Ron Filadelfo, Mr. Jonathon Mintz, and Ms. Nilanthi Samaranyake. We would also like to thank Ms. Jessica Beels, Mr. Don Boroughs, Ms. Linda Fibich, and Ms. Michele Jachimczuk for their skill in editing, graphics, and report layout. Finally, we thank the following individuals, who provided their technical, geopolitical, science, and policy expertise with the CNA Military Advisory Board:

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EXECUTIVE SUMMARY

Water is a necessary and vital resource for all life on earth. Clean fresh water is necessary to sustain our bodies, to grow our food, for much of our energy production or use. It is critical to sanitation, hygiene, and our ability to prevent the spread of disease. Fresh water is so vital to the human condition, conventional wisdom holds that populations would be willing to go to war to ensure supplies.

In 2007, CNA's Military Advisory Board (MAB) identified that, "access to vital resources, primarily food and water, can be an additional causative factor of conflicts" [1]. In 2012, the U.S. National Intelligence Community went further and assessed that "... during the next 10 years, water problems will contribute to instability in states important to U.S. national security interests" [2].

Access to vital resources, primarily food and water, can be an additional causative factor of conflicts.

Since those assessments, the world has seen hundreds of thousands die fighting and millions migrate out of drought-stricken Syria; ongoing civil wars in water-scarce Yemen and Libya; on-going tensions between the nuclear-armed countries of India and Pakistan, which share water resources; and violent extremist organizations (VEOs) including ISIS, Al-Shabaab, and Boko Haram using water as a tool of coercion or influence, from Africa to the Levant. These and countless other examples give credence to the belief that water and conflict are related.

On the other hand, in a review of state-on-state wars, none can be directly and solely attributed to fighting over water resources. Understanding more fully how water stress contributes to violence, conflict, and instability—while historically falling short of causing war—can help decision makers allocate resources to prevent or dampen conflict in critical areas to safeguard U.S. interests and national security.

Water stress occurs when the demand for water by people—whether individuals, local communities, regions, even countries—exceeds the available supply during a certain period, or when poor quality restricts its use.

To begin this understanding, we examined numerous recent examples of violence in water-stressed areas across a conflict spectrum—civil unrest and instability; localized violence; terrorism, insurgencies, and civil wars; and state-on-state conflict. We found that water stress has varying roles in conflict that rarely occur linearly. Prominent in nearly all cases is the role of government and other organizations, like VEOs, which could exert control of or otherwise manage water resources. We found that water management, or the lack thereof, was a dominant factor not only in the availability of water, but also in the trust, confidence, and support that populations have for the organizations exerting control.

As water stress is predicted to expand to new areas and intensify in those already stressed, it is likely to become a more prominent non-traditional security challenge. Driving factors include population growth, demographic shifts, and the emerging effects of a changing climate. Understanding the relationship between water stress and conflict will become increasingly important to protect U.S. interests and national security. Our full findings and recommendations follow.

Water stress is likely to become a more prominent non-traditional security challenge.

Findings

When examining violence, conflict, and instability in areas of the world experiencing water stress, we see water as a factor across a full spectrum of conflict:

Decreased water availability can be the principle cause of civil unrest and localized violence. When combined with other negative factors such as poor governance, poor water management practices, or preexisting social tensions, civil unrest and localized violence can escalate and threaten local governments and U.S. interests, including U.S. citizens abroad, businesses, and supply chains.

Water can bring nation states to the negotiating table to engage in diplomatic talks across a broad range of issues, with water access being both a key bargaining chip as well as a principal objective.

Actual or perceived changes to current or future shared water resources can add to tensions between upstream and downstream states, but this has been and remains unlikely as a singular cause for state-on-state war.

Water stress can be exploited by non-state actors, violent extremist organizations (VEOs), insurgents, and other belligerents. For example, these groups can use control of access to or availability of water to gain power, recruit, and advance their goals. In conflicts involving VEOs such as those in Yemen, Libya, and Syria, water infrastructure has been purposefully or inadvertently damaged, causing new water stress or making existing stress more acute. As such, in these conflicts water infrastructure can take on a strategic value.



Cameroonian soldiers from the Rapid Intervention Brigade stand guard amidst dust kicked up by a helicopter in Kolofata, Cameroon, March 16, 2016. Cameroon struggled with Boko Haram, which now operates out of bases in the Mandara Mountains, Sambisa Forest and Lake Chad Basin.

As the availability of water decreases, it will become a more valuable tool in the operational strategy for belligerents as well as a larger bargaining chip in diplomatic negotiations.

Water stress can trigger destabilizing secondary effects, which can lead to conflict. Diminished water availability can disrupt livelihoods, cause food or energy shortages, and, in extreme or prolonged occurrence, cause mass migration. When people move in large numbers into new communities, whether because of water stress or some other impetus, they can overwhelm existing social systems and contribute to economic challenges. When combined with inadequate governance or non-governmental intervention, these conditions can result in localized violence and/or empowerment of non-traditional governing bodies, such as VEOs or criminal organizations, and can eventually manifest as widespread conflict. In some cases, this can threaten to destabilize governments.

Globally, predicted changes in precipitation patterns, combined with burgeoning populations and changing demographics, will increase water stress across many nations, with three associated growing security challenges:

There will be more and widespread occasions of civil unrest and localized violence, with a greater sense of urgency to change perceived governmental inadequacies. In extreme cases, the disenfranchised will look increasingly to non-traditional governing entities for solutions, which could include VEOs. This will manifest as increased threats to U.S. interests and citizens abroad.

As the availability of water decreases, it will become a more valuable tool in the operational strategy for belligerents as well as a larger bargaining chip in diplomatic negotiations.

Lower availability of or less access to fresh water will likely add to tensions among neighbors sharing river basins, and finding mutually acceptable diplomatic solutions will become more challenging. It is likely that countries will increasingly consider irregular or asymmetric tactics as a means to secure access to water.

In many areas of the world, water stress is the result of poor management, rather than absolute scarcity. Improved water policy can lead to improved agricultural policies, investments in water efficiency, basin-level approaches to water management, and better technologies—all potential paths to reducing water stress globally, and thereby reducing water stress as a factor in conflict.

Recommendations

Security elements of the United States government should regard global water stress as a growing national security concern.

Water stress should be considered an intensifying factor in instability, conflict, and crises that will impact U.S. national interests abroad and likely lead to future U.S. military responses. Consequently, the international community should work to reduce water stress and its effects. This requires a whole-of-government approach.

Diplomacy

In areas of strategic interest to the U.S. and our allies, expand diplomatic efforts, investment, and technical leadership in the mitigation of water stress.

Expand diplomatic efforts to prevent and mitigate conflicts among countries that share water resources.

This will become increasingly important as water stress worsens. Encourage adaptive and inclusive basin-wide agreements to manage transboundary water resources.

Increase U.S. engagement in the development and deployment of water management practices, technologies, and innovations. Share the effective United States methods to mitigate water stress and address its challenges, including advances in agricultural productivity and energy efficiency.

Incentivize private-sector engagement to spur innovation and improve water management practices. Solutions won't come from government alone. Private-sector innovations for managing water, forecasting, and improving supply or demand should be incentivized through grants, public-private investment, and other mechanisms.

Investment

Develop a common foresight tool to identify areas of emerging water stress, with a focus on the potential

for unrest. While there are systems and processes in place at USAID and other agencies to monitor and forecast water stress, track flows, and predict droughts, there is no standard that also addresses the potential for violence and conflict.

Develop stronger communications nodes and strategies for alerting the interagency and the international community to the potential for conflict or violence in water-stressed areas. Just as the Famine Early Warning System, originally set up by USAID, uses standardized communication and transmission nodes to relay information and forecasts on food security vulnerabilities, we recommend that USAID, the academic community, and international organizations that are developing or expanding models and forecasts of water stress consider how to incorporate the risk of conflict or violence.

Defense

Integrate water stress into strategic-level documents and guidance, such as the National Military Strategy and National Defense Strategy, Geographic Combatant Command theater campaign plans, conflict assessments, risk vulnerability, regional planning, and other material.

Incorporate regional water stress information and impact into the U.S. strategy to counter violent extremism. For example, as groups like ISIS, Al-Qaeda, and Boko Haram leverage water stress to gain and sustain power, U.S. strategy to counter VEOs should include greater focus on water stress.

Designate an office within the Office of the Secretary of Defense to be responsible for global water stress and to coordinate across the interagency on water-stress issues. The office would cooperate in support of the whole-of-government approach. In addition, Combatant Commands should track water stress within their area of responsibility and communicate this information back the broader interagency.

REPORT ORGANIZATION

The first section of this report introduces the topic of water stress, violence, and conflict. It also articulates the specific research questions that our team and the MAB sought to answer, and explains the analytic approach we took to do so. We then provide an in-depth description of the issue of water stress today, followed by an overview of what existing research says about the future of water stress globally. This section also assesses current water management approaches and the types of interventions and tools governments have at their disposal to ensure there is enough water to meet

demand. We then present the idea of water stress as one of many factors in conflict and violence, and explore why understanding its role is important, particularly when U.S. interests are at stake. The next four sections are dedicated to examining water stress as a contributor in four types of conflict: civil unrest; localized violence; terrorism, insurgencies, and civil wars; and state-on-state conflict. Finally, we conclude with closing thoughts on the implications of our findings for the United States and what the U.S. can do to address the challenge of water stress going forward.



Members of the Sinjar Resistance Units (YBS), a militia affiliated with the Kurdistan Workers' Party (PKK), place a trip wired improvised explosive device on a track used by Islamic State fighters near village of Umm al-Dhiban, northern Iraq, April 30, 2016.

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INTRODUCTION

Water stress is a growing non-traditional security challenge in key parts of the world. It is spreading globally and rising in prominence as populations grow, demographics shift, and the impacts of a changing climate emerge. This report details how, in water-stressed environments, water stress can be both a direct and indirect factor in conflict and instability, how water stress can exacerbate the underlying causes of conflict, and how it can be exploited by adversaries or extremist organizations. With greater clarity on these linkages, the defense and security community can better allocate resources to reduce the threat or likelihood of conflict in a changing environment.

Why Water

Water is a vital resource. It drives our economy, our society, our culture, and is critical for our very survival. The availability and accessibility of fresh water is essential for economic growth, agriculture, energy production, industry, and, in many areas, transportation. Water is an important factor in stability in key parts of the world and, unlike other natural resources, it has no substitute. The United Nations estimates that by 2025, 1.8 billion people will be living in areas of absolute water scarcity, and two-thirds of the world population could be under water stress [3].

In 2012, the National Intelligence Council released an Intelligence Community Assessment, “Global Water Security,” which found that “during the next ten years, many countries important to the United States will experience water problems—shortages, poor quality, or floods—that will risk instability and state failure, increase regional tensions, and distract them from working with the United States important policy objectives ...” [2].

Water stress can exacerbate the underlying causes of conflict and can be exploited by adversaries or extremist organizations.

Water experts like engineer BGen Gerry Galloway, U.S. Army (Ret.), recognize the tremendous challenge created by today’s growing population and resultant increase in water demand. But they believe that much of this stress could be alleviated through effective infrastructure investment and water management that provides for efficient and equitable distribution of the water supplies that are not always located in the areas where they are most needed.

Governments have a great number of options and controls available to manage water supply and demand. On the supply side, they control storage and delivery through dams, aqueducts, and piping systems; they can determine how much ground water can be pumped and by whom; they can invest in desalination or rely on water controlled by upstream neighboring countries. Through policy, they also control water quality.

Governments also control water demand through agricultural policy, sanitation and waste management practices, and decisions on energy generation, and by fostering or dampening water-intensive industries. In most countries, governments—from the local to the national level—are key in determining how water resources are used: Good decisions about water will limit water stress; poor decisions will bring it about or make it worse. Mismanagement of water can be a source of great friction among people and nations and can spur dissatisfaction, violence, and conflict.

A number of today’s existing security concerns—the civil war in Syria and the mass movement of people from Africa and the Middle East—are occurring (or

began) in areas of water stress and poor management of water resources. Understanding the ways water stress can act as one factor in these conflicts is key in identifying how the U.S. can more effectively respond to and manage current conflicts and instability where it has direct national security interests, as well as how to prevent such developments in the future.

Water stress is not the only non-traditional security challenge emerging today. We are seeing an increasingly complex global security environment, with security challenges arising from state adversaries and competitors as well as from non-traditional sources. For example, belligerent actors—including violent extremist organizations, insurgents, and non-state armed groups—complicate the range of threats the U.S. must confront. Transnational threats such as

criminal organizations, trafficking networks, and pirate syndicates are on the rise, undermining global security and contributing to instability and violent conflict. Understanding the role of water stress as these new complexities emerge is critical to determining how to allocate limited resources.

Globally, we see three trends driving water stress: 1) population growth, 2) changing demographics, 3) climate change.

Population Growth. Today's world population of 7.6 billion is expected to grow to 8.6 billion in 2030, 9.8 billion in 2050, and 11.2 billion by 2100 [3]. The United Nations estimates that half this growth will be concentrated in just nine countries, the Democratic Republic of the Congo, Ethiopia, India, Indonesia, Nigeria,

Population of the World: Estimates, 1950-2015, and Medium Variant Projection with 95 percent Prediction Intervals, 2015-2100

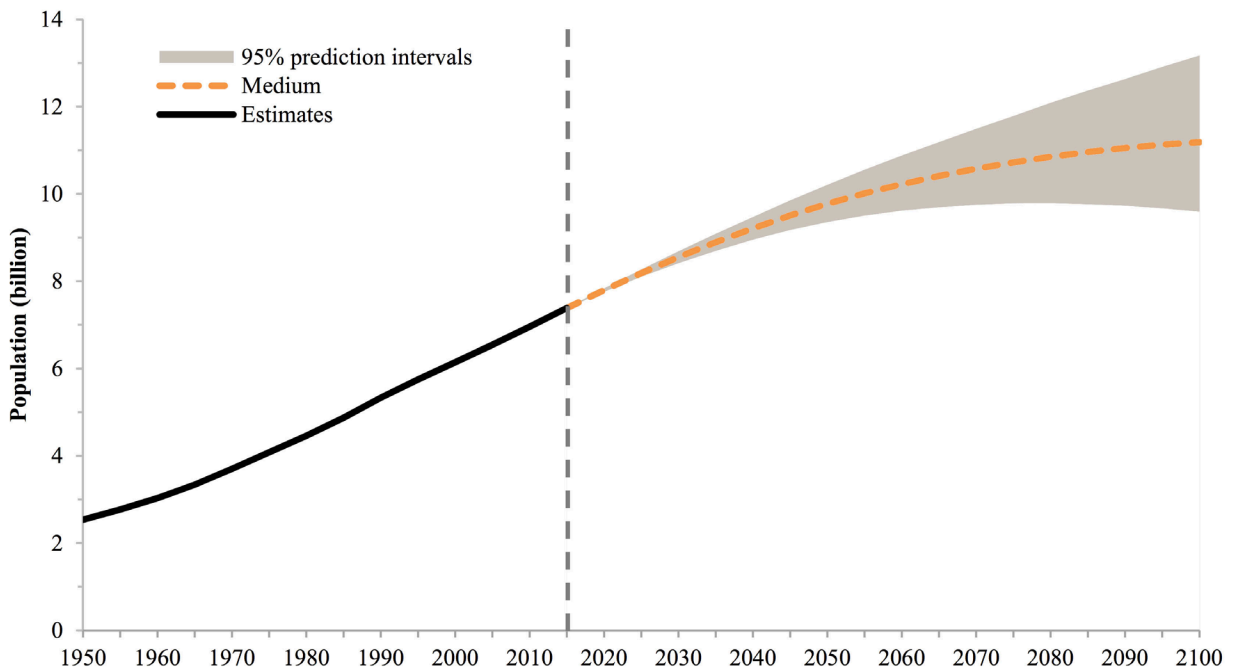


Image credit: United Nations, Department of Economic and Social Affairs, Population Division (2017). *World Population Prospects: The 2017 Revision*. New York: United Nations.

Pakistan, Uganda, the United Republic of Tanzania, and the U.S. [3]. Portions of all but two of these nations are under high or severe water stress now [4]. Increasing water stress due to population growth could put significant stress on the availability of water for agricultural production, industry, and power generation, as water is a key component in meeting these needs.

Changing Demographics. Migration, urbanization, and rising affluence will put greater pressure on fresh water resources globally. The United Nations reported in 2016 that the number of migrants has grown from 173 million in 2000 to 244 million in 2015 [5]. By 2030, it is expected that 60 percent of the global population will be living in cities, putting greater stress on urban water resources [6]. At the same time, rising affluence, particularly in the emerging economies of Africa and South Asia, is driving more water-intensive

changes in food consumption patterns (e.g., more meat and certain grains).

Climate Change. With temperature rise, changes in precipitation, extreme weather events, and sea level rise (leading to saltwater intrusion into our fresh water resources) the availability of fresh water to meet the agricultural, energy, and human security needs of a population will increasingly be in doubt. Water stress will increase (from both floods and droughts), with expected impacts on human health and food security. The impacts of a changing climate have already proven to be a trigger in refugee dynamics and political instability.

All these trends foretell more water stress, potentially for everyone, and to some degree impacting all countries: our allies and adversaries, trading partners, fragile and stable states alike.

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ANALYTICAL APPROACH

The core inquiry behind this paper is to understand whether—and in what ways—water and water stress are factors in conflict and instability in key regions around the world. Our analysis is centered on the following themes:

Conflict is rarely, if ever, caused by a single factor [7-8]. Rather, conflicts usually result from a complex mix of multiple factors evolving over time. Understanding these various factors can be a powerful force in identifying potential security interventions to avoid or end conflict.

Given the complex nature of conflict, establishing direct causation between water stress and conflict and instability is not easily accomplished, nor necessary, to understand why it is important to national security. Rather, we focus on understanding water stress as one of many possible factors present in conflict and instability, and in what ways it plays out.

To understand the conditions where water stress is a factor in conflict and instability, we examined events occurring in the last five years in locations where water stress (and its conditions) also existed.

Our approach used the following analytic steps:

Determine which conflicts to examine. To determine which instances of conflict and instability had national security implications for the U.S., we relied on a number of data sources: 1) the Council on Foreign Relations Global Conflict Tracker, which at the study's inception identified 28 instances across the globe in which conflict is "likely to trigger U.S. military involvement or threaten the supply of critical U.S. strategic resources" or "affects countries of strategic important to the U.S. but does not involve a mutual-

defense treaty commitment"; 2) the Armed Conflict Location and Event Data (ACLED) Project, which maps occurrences of conflict in Africa and Asia and enabled us to examine more localized conflict, including political violence and protest events; and 3) the Pacific Institute's Water Conflict Chronology, news reports, and extensive existing research on water stress and its relationship to instability and conflict [9-11].¹

Define water stress. Many models try to qualitatively and quantitatively discern varying levels of water stress around the globe. Models focused on how climate change will impact water stress tend to highlight changes in water supply, holding water demand static. Models aimed at examining impacts to sanitation and hygiene will highlight factors that drive human security. Our investigation of the human response to water stress (civil unrest, violence, or conflict) needed a comprehensive approach that considered variation in supply in addition to the full continuum of water demand associated with economic as well as human security needs. After discussion with experts on the CNA Military Advisory Board and others, we gravitated to the World Resources Institute water mapping tool Aqueduct, The Water Risk Atlas. Aqueduct assigns an ordinal level of water stress by weighting the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use and incorporating regulatory positions as well as media and public perceptions of water availability. Higher values indicate more competition among users [4].

Focus on water stressed areas. We bound our analysis to conflicts occurring in water-stressed areas. We formulated our thinking on water stress through discussions with water experts (hydrologists, climatologists, environmental scientists, analysts, researchers, etc.) from leading think tanks, academic institutions, and within the U.S. government, who

¹ We relied on an extensive body of existing research on the issue of water stress and scarcity as a factor in instability and conflict, including work by David Michel, Marcus King, Peter Engelke, Josh Busby, Peter Gleick, and Thomas Homer-Dixon. In addition, we consulted U.S. government research such as the ICA and the NIC reports. Finally, we also conducted meetings with experts in the field of environmental and water security. Much of the existing research on this topic has been conducted in the form of case studies focused on a single country or situation. We relied heavily on these existing case studies as well.

provided additional data on the intersection of conflict and water stress. We leveraged the World Resources Institute water mapping tool Aqueduct, The Water Risk Atlas, to assess the degree to which the selected instances of conflict were occurring in water-stressed areas [4]. We then categorized the geographic location of selected conflicts according to Aqueduct's Water Risk Score, focusing on conflicts with "high" or "medium high" scores for our research on the role of water stress in each conflict.

Develop a framework to examine different types of conflict. In our preliminary literature review we found that much of the research on water and conflict is focused on two types of conflict: interstate and subnational. However, some experts, particularly in the field of conflict studies, recognize a broader spectrum of conflict types [11-13]. The U.S. Department of Defense also embraces this more nuanced view, placing conflict along a continuum. For example, the 2015 National Military Strategy identifies three types of conflict: state, hybrid, and non-state, but is silent on civil unrest and localized violence in its framework

[14]. To allow more comprehensive analysis of water stress specifically, we adapted the DOD continuum to include conflict at the lower end of the spectrum: civil unrest and localized violence, as illustrated in the image below with definitions in the table following. Civil unrest and instability account for activities that fall below the threshold of violent armed conflict, but are important for understanding how some water-stressed situations can escalate into conflict over time. The localized violence category captures recorded violence in local water conflicts that fall below the level of being sufficiently organized to undermine governments or gain control over populations.

Examination of conflict and instability across the spectrum. For each type of conflict occurring in water-stressed areas, we sought to answer the following: 1) Does our data demonstrate that water stress is/was a factor in that conflict category? 2) If so, how? What are the examples? 3) What are the implications of the role of water in that type of conflict? 4) How can this be applied to the changing global conditions of water?

Spectrum of Conflict

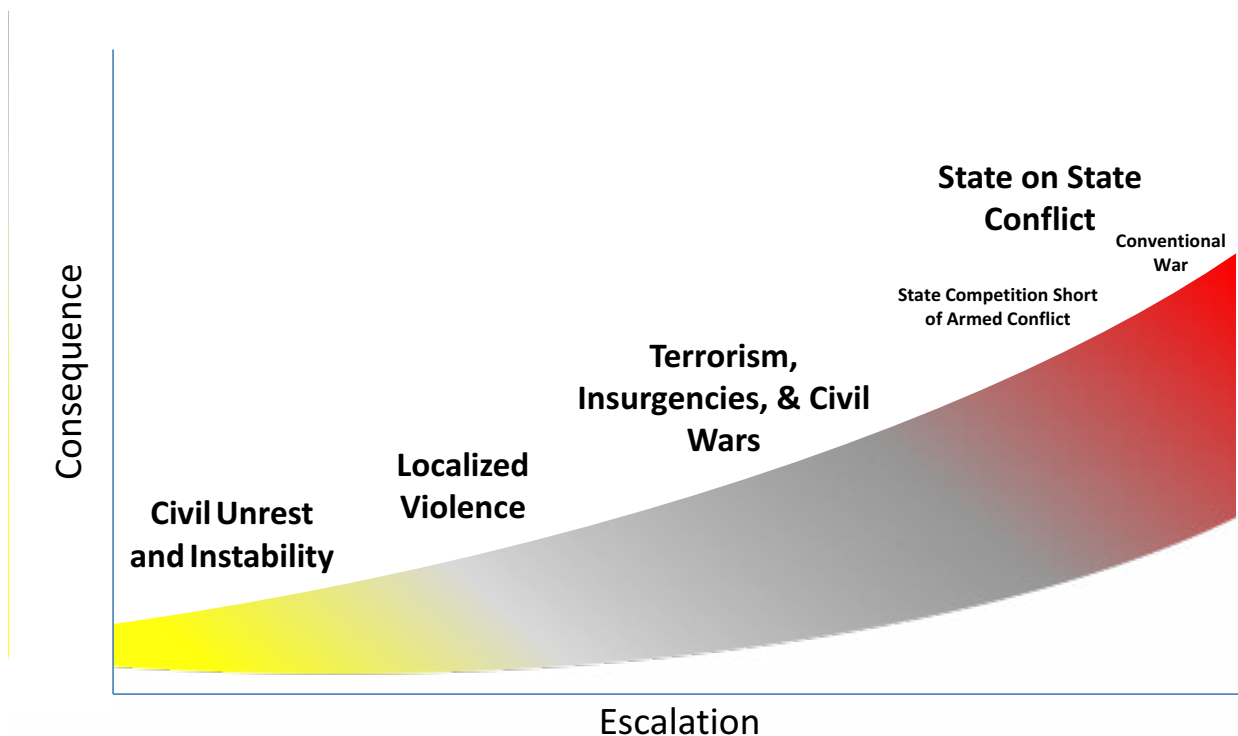


Image credit: CNA

Identification of trends and feedback. We analyzed our data on instances of instability and conflict occurring in water-stressed areas to identify trends and patterns in how water stress has factored into each type of conflict. To garner input and insight, we interviewed experts from organizations ranging from academia and think tanks to the Department of State, USAID, the U.S.

Department of Defense, and regional experts. Military Advisory Board members provided feedback on our findings and conclusions, as well as guidance for further analysis. Experts and CNA MAB members also drew from their own operational experiences over the course of their careers to give additional real-world insights.

Table 1. Types of Conflict and Their Definition in the Context of This Study

Type of Conflict	Definition
Civil Unrest and Instability	People participate in activities to express dissatisfaction with their government, including riots, protests, and sit-ins. Unrest can lead or contribute to instability when it reaches a level that threatens the foundations of local, state, and/or federal government.
Localized Violence	Fighting among civilians over a specific resource. Examples include violence between two communities, such as tribes, ethnic groups, or villages and towns.
Terrorism, Insurgencies, and Civil Wars	Violent struggles that involve non-state actors competing for legitimacy and influence, typically to control territory and populations. In these types of conflicts, non-state actors, such as VEOs, militias, and terrorist organizations, often employ small units and networks to engage and undermine local and central governments [14].
State-on-State Conflict	Competition short of armed conflict: An ambiguous form of interstate conflict below the threshold of conventional war or, in some cases, even below the threshold of military force or violence.
	Conventional war: Employs a large-scale military force and sophisticated military technologies across multiple domains to defeat the enemy [14].

WASH: WATER, SANITATION, AND HYGIENE

In many parts of the world, the biggest water challenge is not quantity, but quality. Industrial activity, agriculture, poor land management, lack of infrastructure for sewage, saltwater intrusion, and other natural and human activities can lead to pollution at levels that render water resources unsafe. For the 660 million people without access to improved drinking water resources and the 2.4 billion people who lack access to improved sanitation, this quickly becomes a matter of life and death [16]. It is estimated that nearly one quarter of childhood diseases and deaths could be prevented through access to improved water and sanitation systems [16]. Investments in Water, Sanitation, and Hygiene (WASH) can resolve the challenges that unsafe drinking water and inadequate sanitation systems pose to communities. On the other hand, inadequate investments or management of WASH infrastructure can also create tension between communities and their neighbors or government.

Absent WASH infrastructure improvements, vulnerability to water stress rises. When pollution renders a water resource unusable, for example, the surrounding community will experience water stress, despite the fact that there is water in adequate quantities. When the cause of the pollution can be traced to a responsible party or individual, conflict can occur.

Improving global WASH infrastructure is a long-term priority of many governments, faith-based organizations, nongovernmental organizations, and multilateral organizations like the UN and WHO. Through initiatives by USAID and the U.S. Department of State, the U.S. government has improved access to drinking water and sanitation for 3.4 million people [17]. The result of improved WASH infrastructure is greater water security, resilience, and health outcomes for communities that expand individuals' access to economic activities and better lives.

UNDERSTANDING AND MANAGING WATER STRESS

Water stress occurs when the demand for water by people—whether individuals, local communities, regions, even countries—exceeds the available supply during a certain period, or when poor quality restricts its use [147]. Yet when investigating its effect on violence and conflict, it is critical to understand the drivers of water stress and where interventions by governing bodies may mitigate those effects. In this chapter we identify the major contributing factors to water stress and where opportunity exists—on both the supply and demand sides—for governments to engage to reduce risk.

Supply

While the world does have an abundance of water, the vast majority is in the form of salt water in the oceans. Less than three percent is fresh. Of that, nearly 70 percent is trapped in glaciers, ice caps, or permafrost, and another 30 percent is estimated to be underground [15]. This means that most of the world's freshwater is unavailable to meet the needs of nearly 8 billion people. Water stress is often a distribution and management problem (versus a scarcity problem) as the rivers, lakes, basins, and groundwater resources providing fresh water are not always where they are needed to support a community or population.

Local and national governments often alter the natural distribution of fresh water through dam building, major municipal ground water pumping systems, development of artificial lakes and reservoirs, advanced water distribution systems, treaties and other agreements for access to cross-border water supplies, and even the conduct of global trade in virtual water (water-intensive commodities, goods, or services). For a given population, access to water resources can be restricted by government policy or by boundaries or borders that cross natural watersheds, shared lakes, and river basins. Control and influence over water distribution systems and infrastructure by a community, a governing entity, or a nation are often the source of friction over water access.

Through control of water infrastructure, water supply systems, and water access, governments and governing entities have influence over industry, agriculture, human health, energy generation, and other components that drive the economy and the security of a population. Access to these systems can be used by governments or others, like extremist groups or insurgents, to control or influence populations relying on those water resources. Additionally, in times of conflict or natural disaster, impacts on vulnerable infrastructure can affect the supply of fresh water to a population.

In addition to policies that control distribution of fresh water, governments control policies and practices that assure water quality. For example, government policies and regulations can control industrial pollution and waste water treatment, the use of natural and artificial fertilizers in watersheds, or deforestation that impacts sources of potable water. In this manner, government

Through control of water infrastructure, water supply systems, and water access, governments and governing entities have influence over industry, agriculture, human health, energy generation, and other components that drive the economy and the security of a population.

oversight, intervention, and management of water supply are critical components in the water stress equation.

Demand

On the demand side of the water stress equation, the need for water can range from the amount required for

basic human survival to that necessary for economic prosperity. For survival, populations need water for the body, for food and agriculture, for sanitation and hygiene, and for ecosystem health. Then, as a driver of economic prosperity, populations demand water for industry, for energy generation, to support transportation, and for culture and larger ecosystems. Each of these sectors, needs, and demands competes with the others, and, in areas or times of water stress, this competition can drive tension and conflict. Government and non-government organizations can exert influence with programs, regulations, and incentives that, individually or collectively, can drive water demand and, in some cases, mitigate water stress.

Globally, agriculture has the highest demand for fresh water, with nearly 70 percent of the world's fresh water consumption going to crops and feed stock [18]. With increasing population and affluence, global agricultural demand will continue to rise. Demand can be managed through incentives to grow fewer water-intensive crops in areas of water stress, research on efficient crops and irrigation, access to water supply infrastructure, subsidies or incentives driving water use, and other efforts. Smart agricultural policies can mitigate the potential risks of water stress.

As economies emerge and global affluence increases, we will see growing demand for more water-intensive food and for water used in energy, resulting in increased competition over water resources between the energy sector and needs for agriculture and human health. Use of water for hydroelectric power generation, as an input for biofuels, and for cooling of fossil- and nuclear-powered plants, are just some examples of the water-energy connection. Vast quantities of water are also used in refineries, and water is now a key input in the extraction of unconventional oil and gas. Government policy and practices often arbitrate competing demands and become the source of perceived inequities around the world.

Tied closely with the energy sector is the need for water for industrial use. Whether in fabrication, washing,

diluting, cooling, transporting, or direct incorporation into products, industrial use of fresh water can limit its availability for a community or population and/or reduce its quality below the level required for such needs as agriculture or human health. Government regulation can influence the types of industry developed in an area, manage competing demands for water among different sectors, and ensure that human health needs are met.

Water must also be leveraged for transportation. Without careful management, competing demands for water, coupled with impacts of climate change, could have a direct impact here. In many areas of the world, waterways transport raw materials and finished products to manufacturers, consumers, or transshipping points. When there is insufficient water to move ships and barges, more expensive transport methods are required, which may make certain endeavors unprofitable. For example, recent droughts in Europe have lowered the levels of the Elbe and Danube Rivers, suspending barge shipping and river cruises at significant cost to merchants along the route. Dams, canals, and government policies that alter or extract water from waterways have direct implications for transportation.

Why Is Water Stress Important?

As the dynamics of water stress fluctuate due to changes in population, affluence, and a warming climate, government policies and procedures to manage water supply and demand will become critical. Negotiating and managing cross-boundary water treaties; basin-wide water management; and equitable supply across localities, regions, and nations will become ever more challenging. On the demand side, strong and innovative policies that balance the competing water needs of food, energy, industry, and transport are critical for human health and economic prosperity. Governments failing to appropriately manage water stress—for their own populations and their neighbors—risk violence and conflict.

Water Stress and Megacities: Potential for Crisis

One of the most significant global trends impacting demand for water is the rise of megacities. Over half the world's population lives in cities. More than 500 have at least a million inhabitants—home to 1.7 billion people in total—and the number of these cities is projected to grow [6]. A quarter of all cities already face water insecurity, and demand by cities for water is expected to grow by 50-70 percent in the next 30 years [19].

Although urbanization presents challenges at every scale, the growing prevalence of megacities (those with a population exceeding 10 million) illustrates them in especially stark terms. The rise of megacities threatens to concentrate both the impacts of water stress and the possible resulting unrest. Today, there are 31 megacities—a number expected to increase to 40 by 2030—nearly 80 percent of which are in Asia, Africa, or Latin America, and many in countries that already face development challenges [6, 20]. Cities, including megacities, can be engines for economic growth, providing job opportunities to millions. But this concentration of people and assets leaves cities especially exposed to shocks such as natural disasters or conditions of water stress. Every megacity, many of them national capitals or financial centers, faces specific water-related issues [21].

Nearly two-thirds of megacities are on or near coasts. The World Bank identified about half these cities as potential or actual natural disaster hotspots vulnerable to flooding. Flooding can result in saltwater intrusion, pollution, or overwhelmed wastewater infrastructure, leading to contaminated water supplies or destruction or other disruption of supply infrastructure [21, 23]. Megacities in arid regions also face water-stress challenges: Mexico City is sinking—in some areas up to 16 inches per year due to its reliance on groundwater extraction for more than two-thirds of its water supply [21-23]. One area has sunk 30 feet over the last 75 years [22].

Megacities in emerging economies especially struggle to provide clean water and sanitation to their growing populations. In Karachi, for example, contaminated water kills 30,000 people (mostly children) each year [21]. As in cities of all sizes, water stress threatens megacities by impacting the availability of water, food, and energy. Water-stress-induced migration may lead to greater urbanization, including new and larger megacities, further stressing resources [19].

Vulnerabilities have spillover effects for national security. Megacities' outsized political and economic importance, both domestically and globally, means that effects can reverberate to surrounding communities, throughout a nation, even a world region [21].

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WATER STRESS ACROSS THE SPECTRUM OF CONFLICT

Looking at conflicts occurring in water-stressed areas over the last five years, we see a long list of factors that arguably contributed to the emergence of instability and violence. Factors can be economic, political, social, or due to security/law enforcement, as described in the chart below. These do not all *necessarily* lead to conflict. What’s more, instability and violence across the spectrum from civil unrest and localized violence to traditional state-on-state conflict almost never result from a single factor.

The field of conflict studies widely recognizes that a range of factors can be at play. USAID, for example, employs a Conflict Assessment Framework to identify these factors within intrastate conflicts such as civil wars, with many security and intelligence analysts taking a “root causes” or “drivers” approach to understanding violent extremism [7, 25-26]. Conflicts typically stem from multiple, complex, interdependent factors or drivers that include—but are not

limited to—political marginalization, repression, economic inequalities, and ethnic and sectarian tensions. Each conflict has a unique set of underlying factors, which can include those highlighted in Table 2 below, or others. Our analysis examines the role of water stress as a factor across the spectrum of conflict.

At the intrastate or local level, social, political, and economic inequities or grievances are often at play in conflict giving rise to actors who challenge governments, like insurgent or separatist movements. At the interstate level, national interests involving natural resources, contested borders, and irredentism across international borders can be factors in why nations go to war [26].

In this report, we provide examples from areas around the world in which water accessibility and availability have been contributing factors to instability and conflict, drivers of diplomacy, and/or tools of coercion.

Table 2. Examples of Factors That Can Drive Conflict

Conflict Factor Type	Example
Economic	Grievances related to unequal wealth distribution High unemployment/little opportunity Neglected regions (e.g., poor infrastructure) Natural resource competition (like water)
Political	Marginalization of populations Repression Disenfranchisement Border disputes Territorial disputes Coups Terrorism Separatist movements Contested/illegitimate governments
Social	Ethnic divisions Religious/sectarian divisions History of radicalism/extremism
Security/Law Enforcement	Military repression Human rights abuses Occupation of a region Extended states of emergency

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CIVIL UNREST AND INSTABILITY

Civil unrest refers to a range of activities in which people participate to express dissatisfaction, typically with their government, including riots, protests, strikes, and sit-ins. Civil unrest occurs daily around the world, sparked by any number of social, economic and political factors. Typically, these events remain localized. In some cases, however, unrest can continue, escalate, and lead or contribute to instability—for example, when it is so widespread or involves so many people that it threatens the foundations of local, state, and/or federal government. When civil unrest leads to political instability and eventual government collapse, it may become of strategic importance to the United States, particularly when the instability affects an ally or results in the takeover by a regime unfriendly to the U.S.

Our research shows that unlike other types of conflict and instability, civil unrest can be caused directly by water stress and the conditions it creates. In places experiencing acute water stress, people protest governments or other institutions that set policy impacting water supplies. Those affected also conduct other forms of civil unrest, such as strikes, in response to how water crises are being managed, and take action to raise awareness of their plight, internally and externally. Water stress can also serve as a multiplier or accelerant when other factors—like competition for arable land or government corruption—are already at play.

We anticipate water stress to increase and spread to more places around the world, and water-related civil unrest to expand—even to places without a long history of such events. Recent examples include Californians’ protesting Nestle Corporation for excess water use and Italians protesting the G-7 for climate inaction; both California and Italy were suffering historic drought and water stress.

In addition to climate change and population growth, two additional major trends will exacerbate water stress and raise the specter of violence and instability. The first is the expansion of the middle class in many areas of the world, including Asia and Africa, and the associated demand for more water-intense energy sources and foods

Key Points

Water stress can spark civil unrest over water availability and quality or government water management practices.

Water-stress-related civil unrest often occurs in urban areas.

Water stress can lead to emergence of a “black market” for water.

Water-related civil unrest—when combined with other drivers—can escalate or spill over into surrounding communities.

(like beef). The second is urbanization and the rise of megacities and their associated dramatic demands for water in constrained areas.

Water Stress as a Direct Factor in Civil Unrest around the World

It is well established that many parts of Africa confront water challenges and have for years. Our assessment of conflict in these areas shows that water stress is a trigger for unrest across all regions. In North Africa, for example, Algeria regularly sees demonstrations, protests, and road closures when water is cut off [10]. Neighboring Tunisia sees frequent demonstrations and protests in response to insufficient water [10]. In West Africa, in 2013, Senegal experienced a dangerous water-related crisis when a water main to the capital city, Dakar, was disrupted for over two weeks [27]. Street protests took place as the government struggled to repair the break, leading to clashes with security



Sheikh Ghazi Rashad Hrimis touches dried earth in the parched region of Raqqa province in eastern Syria, November 11, 2010.

forces. The Democratic Republic of Congo has regular demonstrations and protests over the lack of drinking water, which is periodically linked to rivers polluted by poor mining practices [10].

Zimbabwe, which has been in extended drought, is seeing civil unrest and the rise of a black market for water [10, 28]. These black markets, or “water mafias,” emerge when people are not able to access clean water, particularly in dense urban areas [28-29]. In Nairobi, Kenya, a black market for water emerged in part due to government failure to extend water infrastructure into poor areas [29]. As is the case in Zimbabwe and Kenya, these water black markets are unregulated, leaving vendors open to selling contaminated water and increasing the cost of water at their will [29]. We assess that the emergence of such markets can contribute to resentment within affected populations and potentially spark unrest as a means of expression.

In South America, several countries are experiencing water stress related to ongoing drought and poor water management practices. Bolivia, for example, is in its worst drought in 25 years. Its leaders declared a state of emergency in November 2016 when residents demanding government action resorted to taking hostages. There have been protests in larger cities and reports of conflict between “miners and farmers over the use of aquifers” [30]. Rationing was put into place, and the military has been involved in distributing water to the public in major cities, including La Paz.

In Mexico, provision of water to the near 9 million inhabitants of Mexico City is imperiled by an inefficient system prone to leakages, contention at the source of water, and high prices. In July 2014, residents of San Bartolo Ameyalco, a highland suburb, clashed with some 1,000 police in riot gear over water rights [32]. More than 100 people were injured as protesters threw rocks and bits of concrete and police retaliated [32]. The conflict is

emblematic of the greater water crisis. Mexico City's own water, in deep aquifers, is critically depleted, quality is low, supply is unreliable, and the price of pumping it to the surface is high [33]. The surrounding communities and regions have water, but residents object to being forced to share what they depend upon [32]. Citizens of San Bartolo Ameyalco say little attention has been paid to their needs or to fair compensation [32]. Many regional suppliers of Mexico City's water are indigenous groups who are already distrustful of the government, which they claim takes advantage of their resources while ignoring their needs [31].

Below we present three cases studies that illustrate the association of water stress in civil unrest, including Kenya, India, and Iran.

Water-stress-related civil unrest is often linked to extended periods of drought made worse by poor management and storage practices.

Kenya: Extended Drought and Poor Water Management Practices

Water-stress-related civil unrest is often linked to extended periods of drought made worse by poor management and storage practices. Kenya, which has been an important U.S partner particularly in the fight against the Al-Qaeda-affiliated Al-Shabaab in neighboring Somalia, is in a drought that began in 2014 and now affects 27 of the country's 43 counties [34]. The water crisis has sparked civil unrest, with regular reports of people demonstrating and protesting, including in the cities of Nairobi, Garissa, and Katarina [10, 35].

So far in Kenya, water stress has acted only as a trigger of civil unrest that has not escalated. However, the country faces other challenges that include political

unrest and tensions, ethnic divisions, terrorism, crime, and high unemployment. In addition, the extended drought is causing food insecurity. Given this layered combination of stressors, unrest could escalate and become destabilizing, with water stress a contributing factor.

Water Stress Leads to Riots in India's Silicon Valley

In India, the Cauvery River flows from the state of Karnataka through Tamil Nadu and into the Bay of Bengal. Both states rely heavily on the Cauvery's water for municipal use, irrigation, and industry. Bangalore, a city located in Karnataka and the "Silicon Valley" of India, depends on the Cauvery for drinking water. Disputes over the river date back to British colonial rule. Despite Karnataka's upstream position, Tamil Nadu has received substantially larger allocations—at times up to three times greater than Karnataka's [36]. Population growth, more water-intensive farming techniques, and industry have rapidly increased demand in the region, straining cooperation on water sharing [36].

This was compounded by the construction of large dams and development of new irrigation systems in both states during the 1960s and '70s which significantly decreased the quantity of available water [36].

Conflict over the Cauvery escalated during the early 1990s, and when Karnataka was ordered by India's Supreme Court to provide relief to Tamil Nadu in 1991, violence erupted. Kannadigas attacked Tamils living in Karnataka; Tamils living in Tamil Nadu responded with attacks on Kannadigas. From 1991 to 2016, tension simmered as a basin tribunal attempted to find a solution [36].

Meanwhile, drought had severely decreased the availability of water in both states [37-38]. As it had in 1991, the Supreme Court ordered Karnataka to release water to Tamil Nadu—12,000 cubic feet per second daily for about two weeks in September 2016 [37]. The order was met with protests in Bangalore, where angry crowds burned cars and attacked Tamils in the streets [37-38]. Over 15,000 officers were deployed to enforce an emergency law

that prohibits gatherings in public areas [37]. A wetter than average monsoon season in 2017 has temporarily alleviated some of the stress on the Cauvery watershed.

Conflict over Local Water Distribution: Iran

In Iran, total annual water withdrawals doubled between 1975 and 2004, driven by growth in the country's population, economy, and incomes. As a result, since the 1979 revolution, the per capita quantity of Iran's renewable water supplies has dropped by more than half, to a level commonly associated with the benchmark for water stress [39]. Even more troubling, in large swaths of the country, demand for fresh water exceeds supply a third of the year [39]. Fourteen years of drought have contributed to the problem, as has poor resource management, including inefficient irrigation techniques, decentralized water management, subsidies for water-intensive crops like wheat, and dam building. As a result, parts of the country are experiencing unrest related to water stress.

According to one estimate by the Isfahan Chamber of Commerce, 2 million people—40 percent of the local population—have lost their incomes as a result of the Zayandeh Roud river basin drying up [40]. The diversion of water from Isfahan Province to other, growing provinces in Iran has led to sometimes violent protests, including an incident in which farmers destroyed pipeline infrastructure carrying water to the city of Yazd for industrial use [11, 41]. The protests and destruction led to clashes with riot police [42].

In the country's northwest, Urmia Lake has lost 95 percent of its water over the last two decades from a combination of environmental and human factors, including drought, poor water management, and

increased irrigation [43-45]. Increased salinity of the saltwater lake has disrupted the ecology of the remaining portions, impacting local economies and potentially threatening nearby agricultural land [43-44]. Several protests in the city of Tabriz over the lake's disappearance have turned violent after crackdowns by government security forces [45].

Water Stress, Food Security, and Civil Unrest

Civil unrest associated with water stress can be associated with water conditions geographically separated from where the unrest is taking place, such as when a population in one location is dependent on an import—wheat, for instance—from another part of the world experiencing drought. For example, prior to the 2010–11 uprisings in the Arab world, extended droughts in Russia, Ukraine, and parts of China led to widespread increased wheat prices, including in Arab nations dependent on imports [46]. The rise in food prices, experts conclude, was a factor (among many) in the political upheaval that swept the Arab regions, leading to government collapse in Tunisia, Egypt, and Libya, and eventually the civil wars in Syria and Yemen [46-47].

The revolutions in the Arab world began in most cases as civil unrest, with people participating in protests and demonstrations. Only later did they escalate into widespread upheaval and, in the cases of Tunisia, Libya, Syria, and Yemen, full-blown insurrections. Some of these turned violent as governments responded. In Tunisia and Egypt, drought-related higher food prices joined multiple other factors in driving unrest, including government corruption, economic stagnation, lack of employment and opportunity, and press crackdowns [48-49].

LOCALIZED VIOLENCE

Localized violence refers to fighting among civilians or communities, such as municipalities, tribes, ethnic groups, villages, or nomadic and sedentary groups at the local level. The violence can be limited to populations or involve police or paramilitary organizations. Like civil unrest, localized violence occurs daily around the world, sparked by any number of social, economic, and political factors. By our definition, these events remain localized; however, the violence can be long lasting or escalate or at times cross international borders. If localized violence threatens U.S. interests—U.S. citizens, property, businesses, or critical supply chains—or if it threatens the stability of a government, it may become of increasing strategic importance to the United States. This is so particularly when the government in question it is a U.S. ally or partner.

The causes of localized violence usually are not directly related to water stress, particularly where there are strong mechanisms for resolving such disputes, as is the case in many parts of the world. However, we found that water stress can be an important contributing factor in parts of Africa, the Middle East, Asia, South America, and other places where localized violence is widespread and where there is high public dissatisfaction and resentment over weak or poor governance in other areas.

In these areas, civilians competing for access to water or arable land may engage in violence or damage/destroy infrastructure to deny others access. Examples include communities attempting to secure livelihoods amid heightened competition for scarce resources, or one group being forced to move into another's territory in search of water. In areas such as Afghanistan, Kenya, and Morocco, water has traditionally been managed at the local level by councils or tribal elders, who resolve challenges and disputes among communities [50-54]. In Yemen, long-standing rules regulate the use of water and serve to settle disputes over usage [55]. We have found that disruptions of these traditional means of resolution, stemming from warfare or even legal reforms, could lead to local conflicts over water.

Key Points

Communities compete over water resources, but often there are local mechanisms in place to resolve such disputes peacefully.

When mechanisms for resolving water conflict at the local level break down, disputes over water can turn violent.

Prominent examples of localized conflicts are those between herding communities clashing violently with local farming communities over land.

Localized violence has the potential to escalate internationally if water resources are shared across state borders.

Should projections of increased water stress in major portions of the world manifest, we assess that localized violence associated with water will likely increase unless governments widely embrace better water management practices, particularly resolution of disputes over arable land.

The case studies that follow demonstrate the association of water stress and localized violence in water-stressed parts of Africa and the Middle East.

Localized violence associated with water will likely increase unless governments widely embrace better water management practices.

Competition Over Land Use and Water: Localized Violence in Africa

For decades, in parts of Africa under water stress, grazing land has become limited and semi-nomadic herders have clashed violently with local farming communities over resources for fodder.

In Nigeria, for example, armed Fulani herdsman have attacked settled farming communities, requiring Nigerian President Muhammadu Buhari to order in security forces [11, 56-58]. According to the Global Terrorism Index, more than 1,200 people died in these clashes in 2014 alone, and thousands have been displaced [59]. Experts cite poor water management practices as a cause of the growing competition and violence [60].

In Kenya, fighting between Borana herders and Burji farmers in a region vulnerable to drought killed at

least 56 people in 2013 (nearly twice the toll of the year before). The violence, “rooted in historic clan rivalries and competition for water and pasture in the arid region,” is exacerbated by competition for power in a new system of county governments; oil exploration and renewable energy developments, which further drive water stress; an influx of assault weapons; and support from militias in neighboring countries. Protests and destruction have precipitated clashes with riot police [11, 61]. In 2017, the Kenyan military was deployed to the Rift Valley region to stem violence between communities as a result of ongoing water stress caused by drought [62]. Recent months had seen the deaths of 21 people in related violence [62].

Somalia has also seen violent localized conflict over water resources, particularly as drought conditions worsened [11]. “Water, pasture, and politics” are cited as drivers of conflict beginning in 2013 between the



Near Baragoy, Kenya, a Turkana tribesman from a pastoralist community carries his gun in order to protect his cattle from rival Pokot and Samburu tribesmen, February 13, 2017.

rival Dir and Hawadle clans in central Somalia [63-64]. According to a report by the UN Office for the Coordination of Humanitarian Affairs, the conflict originated over competition for irrigable land around the village of Deefow. Between 2013 and 2015, it claimed 100 lives, resulted in villages being burned, and displaced 9,000 people [64]. Some villagers accused the local government of complicity in the violence after it failed to intervene [11, 63, 65].

Local Conflict in Yemen Over Water Resources

In Yemen, conflict over dwindling water supplies dates back decades, even before the ongoing civil war [66]. Today, Yemen is one of the most water-stressed countries in the world. Conditions are expected to worsen with factors including continuing mismanagement of water supply resources, poor choices in agriculture (e.g., water-intensive cultivation of the stimulant *qat*), and population growth [67-68]. Given the wartime breakdown of the central state, water management is less effective or not enforced [68]. Water scarcity is also due in part to a shift from traditional rain harvesting to pumping groundwater. In 2009, a UN Food and Agriculture Organization (FAO) report forecast that Yemen could be the first country to lose its groundwater resources completely; others predict that Sana'a, Yemen's largest city, could run out of water within the decade [69-70]. The current conflict has made the situation even worse; FAO experts estimate that 80 percent of the population—20 million people—lack access to clean water [70].

The Yemeni Ministry of Interior has estimated that 4,000 die annually as a result of violent clashes over land and water [11, 69-71]. It is also estimated that 70-80 percent of conflicts in rural areas are about water [69, 71]. In 2013, prior to the current hostilities, residents

It is also estimated that 70-80 percent of conflicts in rural areas are about water.

of the city of Taiz were only able to run their taps for 36 hours every 30 days, otherwise relying on delivery of water by truck [71]. There were accounts of fighting between two nearby villages over a shrinking water supply going back to at least 2000, killing six villagers and injuring many others. One victim stated, "It wasn't about politics. It wasn't about the Muslim Brotherhood. It was about water" [71]. That same year, a former minister of water and environment, Abdul Rahman al-Eryani, is quoted as saying: "Wherever in Yemen you see aquifers depleting, you have the worst conflicts" [71]. Water-related conflict in Yemen is seen also in the activities of Al-Qaeda's branch in Yemen, Al-Qaeda in the Arabia Peninsula (AQAP), which we discuss later in this paper.

Water-stress-induced localized violence can transcend national borders and involve international politics, raising the security threat to the national and global levels.

Local Communities in Mexico Compete Over Water

There are also instances of local communities competing over water in Mexico, which is experiencing water stress. For example, in Chihuahua State, Mexico, the cultivation of water-intensive crops, the expansion of irrigated areas, and population growth have overtaxed the water supply. As supplies run short, friction between Mennonite farmers and another group of farmers known as El Barzón has grown. The Barzón accuse the Mennonites of sinking over 200 illegal wells and the Mennonites have expressed frustration that they are not treated fairly by the Mexican government [146]. Concerns over available water and violence have pushed many of the families in the Mexico colony to consider moving elsewhere. The unsolved murders of three water activists in recent years have contributed to tensions between the Barzón, the Mennonites, the government, organized crime, and mining interests.

When Localized Violence Becomes International

Water-stress-induced localized violence can transcend national borders and involve international politics, raising the security threat to the national and global levels. The Hari Rud River on the border between Afghanistan and Iran provides illustration. It is a source of water for Iran's second-largest city, Mashad, and of irrigation for Herat Province in Afghanistan. As many irrigation channels in Herat have been destroyed or polluted over time, residents of the Kohsan district have tried to divert river water for agriculture. They claim that Iranian border guards shoot at them in retribution; according to Kohsan authorities, 10 villagers have been killed. Officials of Herat Province, which receives development funds from Iran, deny the allegations. The dispute underscores the lack of sufficient water agreements between Iran and Afghanistan [11, 72].

TERRORISM, INSURGENCIES, AND CIVIL WARS

This category of conflict is defined by violent struggles that involve non-state actors competing for legitimacy and influence, typically to control territory and populations, usually against governments. In these types of conflicts, non-state actors, such as VEOs, militias, and terrorist organizations, often employ small units and networks to engage and undermine local and central governments [14]. They tend to favor indirect and asymmetric approaches, and some can employ the full range of military and other capabilities to erode an adversary's power, influence, and will [14, 73]. Today, particularly throughout Africa and the Middle East, these types of conflicts—many of which are within states and not between states—are prevalent. Examples of non-state actors involved include ISIS; Boko Haram; and Al-Qaeda and its affiliates such as Al-Shabaab, Al-Qaeda in the Arabian Peninsula (AQAP), Al-Qaeda in the Islamic Maghreb (AQIM), and its branch in Syria.

Factors at play within conflicts involving non-state actors include ideology, territorial claims, political marginalization, economic inequities, and ethnicity [74]. VEOs are frequently involved, including those listed above. In these conflicts, extremist organizations have demonstrated an ability to exploit political, economic, and social conditions within the areas they operate and seek to operate to their benefit. For example, where there is weak or no government, these groups can move in and provide services, winning them followers and support. Water stress creates conditions these organizations can exploit in this manner—they may provide needed water where the government does not, or cut off supplies to weaken an adversary and turn a population.

While the United States has dedicated considerable resources to fighting terrorist organizations since 2001, and defeating them remains a top priority, their number and strength have expanded, as has the size of their operating areas in Africa and the Middle East over the past 16 years. Despite the exploitation of water stress

Key Points

Water stress creates conditions that VEOs can exploit to their advantage.

VEOs control water access as a tactic to subjugate populations and compete with governments.

Some VEOs seek to control water infrastructure to foster their state-building goals.

VEOs limit access to water to demonstrate power, relevance, and presence.

In water-stressed environments, water infrastructure takes on greater strategic importance.

Loss of economic livelihoods from water stress allows VEOs to recruit and gain power.

by VEOs, addressing water stress conditions has not traditionally been part of U.S. counterterrorism efforts. The security community tends to see water stress as a humanitarian concern and, consequently, responses to date have largely come in the form of humanitarian assistance. Exploitation of these conditions by non-state actors is perhaps overlooked.

Provided below are examples in which organizations including ISIS in Iraq and Libya, Al-Shabaab in Somalia, and AQAP in Yemen have used water resources to their advantage.

Water as a Tool: ISIS' Use of Water to Coerce Populations

Non-state actors within this category of conflict can leverage water to control, coerce, or even punish civilian populations.

In 2014, ISIS took control of territory across Syria and Iraq, including Iraq's largest northern city, Mosul. This coincided with drought conditions and unusually high temperatures for Iraq [75]. As part of its strategy to establish itself as a functioning state, ISIS captured much of Mosul's public-service infrastructure, including the water stations [76]. This rendered the population dependent on ISIS for a basic need. In the early phases of its takeover, ISIS reportedly cut off water supply to surrounding villages, but later offered water and other staples at a discount to Sunnis who had fled the fighting, helping to convince them to return home and live under ISIS control [76-77].

Non-state actors within this category of conflict can leverage water to control, coerce, or even punish civilian populations.

Water Infrastructure as a Strategic Asset

ISIS also has turned off water supplies to populations. According to numerous reports, it cut off water to Mosul when it was defending against the Iraqi Security Forces (ISF) campaign to retake the city. In January 2017, in areas that the ISF had liberated but where ISIS still controlled the water, it cut off supplies to 30 neighborhoods [78]. A UN Security Council report noted that ISIS cut the water supply from the Al Khafseh water treatment facilities on the Euphrates River in mid-

January 2016, depriving 2 million residents of Aleppo for two-and-a-half months [79].

A UN aid worker observed, from Mosul: "There is a clear pattern that we have seen in many of the cities and towns ISIS has occupied: that they will use water, food, anything to coerce the population" [80].

ISIS has also taken control of dams, raising secondary concerns over improper operation and maintenance, or outright attempts to destroy the infrastructure [76]. For example, ISIS briefly seized the Mosul Dam in August 2014, but lost it 10 days later to Iraqi and Kurdish fighters supported by U.S. airstrikes [76]. U.S. officials were reportedly concerned that ISIS could damage or destroy the dam, leading to catastrophic flooding [81]. We can't know for certain what ISIS hoped to gain in holding the dam. But four months before, in April, the group took control of the Fallujah Dam and subsequently displaced tens of thousands of people by flooding farmland near Baghdad [81]. Whatever its intentions, ISIS controlled a major piece of water infrastructure. This served multiple purposes, among the most significant fostering the idea that they could manage large infrastructure and therefore serve as an effective government for the population [76, 82].

ISIS is not the only non-state actor with water in its sights. Al-Shabaab in Somalia has had a history of targeting water infrastructure, particularly during the country's long civil war. As discussed earlier, Somalia for many years has experienced water stress due to weak infrastructure, poor management, and extended droughts. It was reported in 2014 that, according to a member of the Somali parliament, Al-Shabaab had shifted its tactics and "started to cut off liberated cities from the water source so that they can demonstrate some kind of power and presence" [83]. Al-Shabaab also takes control of rivers and prohibits people from areas under government control from accessing the water [83].



Peshmerga fighters walk at Mosul Dam in northern Iraq, August 21, 2014.

Water Stress and Civil War: The Case of Yemen

Yemen's protracted civil war involves a range of militias, VEOs, and government forces (including Saudi Arabia's) all targeting water in operations against whomever they view as the enemy. As described earlier, Yemen has experienced water stress for decades. As a result, water shortages have created a devastating humanitarian situation. According to the UN Office for the Coordination of Humanitarian Affairs, Yemen has 18.9 million people in need of humanitarian aid, more than in any other country in the world [84-85].

The water shortages are in part the result of both Houthi rebels trying to take control of Yemen and Saudi forces trying to prevent the takeover. Their tactics have blocked deliveries of humanitarian food and water aid to more than 80,000 people [66, 86]. In addition, parties to the conflict have destroyed water infrastructure. According to one report: "In February 2016, there

were reports that Saudi planes bombed and destroyed a reservoir that held the drinking water for 30,000 Yemenis; roughly 5,000 cubic meters of water" [66, 87].

Targeting of Water Infrastructure and Impacts on Civilian Populations: Water Stress in a Fractured Libya

In Libya, another country that suffers from water stress, a low-level civil war involves two competing governments and a collection of actors and armed militias, including VEOs such as ISIS. Since the 1980s, much of Libya has relied on water coming from underground aquifers and delivered to populated areas via an extensive network of underground pipes. Libya experienced severe water shortages during the 2011 revolution due to electrical outages and damage to the infrastructure [88]. This continues today. Amid the

ongoing civil war, ISIS recently launched an attack—its second since being driven out of its stronghold in Sirte—on the Great Man-Made River Project station southwest of that city. The Great Man-Made River Project pumps water from the desert region in the south to the coastal areas where the bulk of the population lives, supplying the major cities of Benghazi, Sirte, and Tripoli [89]. Within this conflict, ISIS has recognized the value of water and factored water infrastructure into their operations.

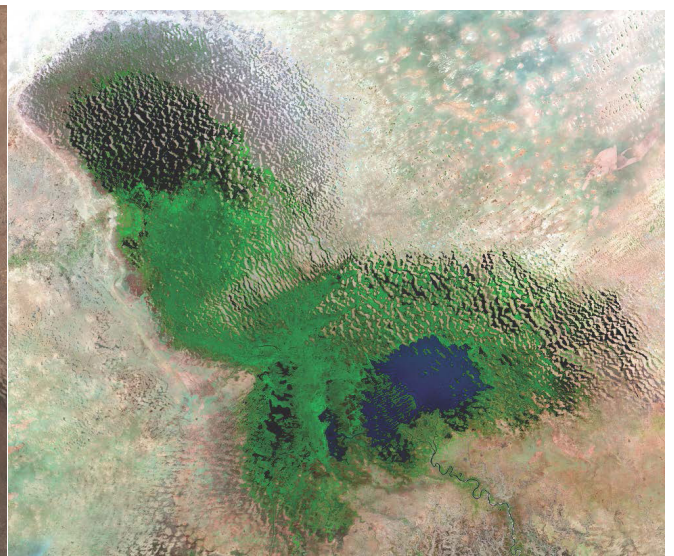
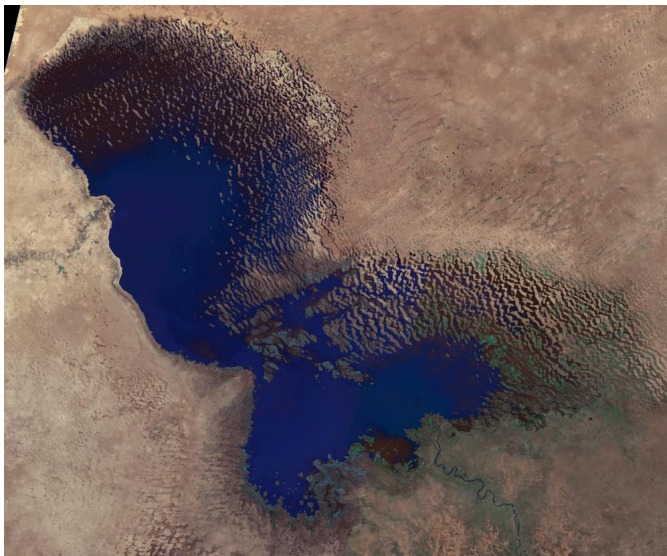
It is clear that in these types of conflicts, targeting water and water infrastructure can disproportionately affect civilians. Cutting off water can have significant negative consequences, triggering refugee flows or, when water infrastructure is destroyed, preventing displaced populations from returning home. What's more, people turn to desperate measures to obtain water. In October 2016, for example, Libyans were digging through pavement in Tripoli and other cities in efforts to get water after supplies were first turned off for maintenance and then cut off by a militia “seeking the release of a leader imprisoned by a rival faction in the capital” [90].

Leveraging Water Stress to Gain Power or Advantage: The Boko Haram Example

The insurgency in northeastern Nigeria, which involves the militant Islamist group Boko Haram, is driven by numerous longstanding factors—including the conditions of water stress. Below we discuss some of these factors.

First, a historical presence of radicalism in the northeastern region of the country, upon which Boko Haram leaders could build and grow, predates the conflict. Second, the central government's response to the emergence of Boko Haram in its earliest years emphasized violence and brutality, at times against civilians. This included mass detentions and extended states of emergency in several northeastern states,

Boko Haram exploits this situation to recruit followers, offering them economic opportunity and secured livelihoods.



Since 1973 (left), Lake Chad has shrunk by over 95% due to withdrawals for agriculture and decreasing rainfall. In 2013 (right), only a small section of Lake Chad's southern lobe remained.

measures viewed as draconian by local populations. Third, the conflict in the northeast has resulted in mass movements of people, both within Nigeria and across borders, as they flee the violence, further destabilizing the region and undermining economic productivity.

Finally, the northeastern part of the country has long-standing grievances over unequal wealth distribution nationally. Economic disadvantages have left the region with poor infrastructure, high unemployment, and little opportunity.

Our research shows that water stress is also an important factor in this conflict. The Lake Chad basin region, where the Boko Haram insurgency is taking place, has experienced water stress for decades. It is estimated that Lake Chad has lost 90 percent of its water since 1963, in part due to ineffective damming methods and poor irrigation practices [91-92]. Much of the population surrounding Lake Chad relied on it traditionally for food and livelihood through fishing. As the lake shrank over the years, these communities were forced into other activities for sustenance and income, including agriculture and raising livestock [93]. People moved, competing with host communities over land for farms and herds [94]. The government of Nigeria has struggled to respond to the challenge of water in the Lake Chad Basin effectively, and pressures have mounted [95]. Economic conditions in the region have become increasingly dire, creating resentment, grievances, and tensions within and among populations.

Boko Haram exploits this situation to recruit followers, offering them economic opportunity and secured livelihoods [96]. At the same time, Boko Haram members experiencing the generalized food and water shortages target vulnerable communities for raids, where they believe they can find sustenance [94].

Conflict Makes Water Stress Worse

Research suggests that, regardless of whether water resources are targeted by non-state actors, when countries experiencing water stress are involved in extended periods of conflict, water management and storage tend to be negatively impacted, worsening the water stress. In Syria, for example, Stanford University researchers found that both the land area being watered by farmers and reservoir storage have decreased by nearly 50 percent since the start of the civil war [101].

In conclusion, extended conflicts involving terrorist organizations, insurgencies, and even full-on civil wars are prevalent in parts of the world today, particularly in Africa and the Middle East. Water stress is a factor in many of these conflicts. The United States is involved in many of them, either directly fighting VEOs or as a supporting partner to a government that is. Given its continued focus on defeating VEOs, understanding the range of factors, including water stress, that enable VEOs to flourish may suggest alternative approaches that the U.S. can employ to counter them.

The Complicated Case of Syria: Parsing Water's Role

The Syrian civil war is not a violent conflict over water. Like most bloody struggles, it was years in the making and fed by complex social, political, and economic factors made worse by disastrous governance. Syria does, however, demonstrate how water stress—resulting from extended drought and poor water management—can be a compounding factor across the spectrum of violent conflict, from civil unrest and localized violence to large-scale wars that involve international powers.

Background: From 2006 to 2009, Syria experienced the worst drought on record, triggering massive migration from hard-hit agricultural areas for city centers [97]. The drought had a catastrophic impact, in part due to the Syrian government's historically poor water management practices for agriculture, which left the country vulnerable, specifically in the northeast, its breadbasket [97-98]. As an estimated million Syrians left their homes, particularly in rural areas, some 1.5 million Iraqi refugees entered the country, further straining resources [97]. The drought's impact and spillover effects were ineffectively managed by the Syrian government as water shortages, spiking food cost, and disease developed into a humanitarian crisis. This was one factor—among many—in Syria's civil uprising and eventual war [98].

Civil Unrest and Localized Violence

The sudden, drought-driven population growth in and around Syrian cities contributed to existing high unemployment, increasing crime rates, and housing inadequacies [97-98]. Riding the wave of popular uprisings in Tunisia and Egypt, as these pressures mounted, Syrians in 2011 took to the streets to protest the Assad regime and its policies. A tangle of factors sparked the Syrian uprising, but deep-seated socioeconomic woes, political repression, and sectarian tensions were already at play within the society [99]. These tensions, compounded by the extended drought, its consequences, and the government's inept response, facilitated escalation of the popular uprising into local violent conflict between citizens and the Assad regime.

Localized Violence

As demonstrations spread and became larger, in March 2011 regime forces shot protesters dead in the town of Deraa, marking the beginning of the Syrian civil war [100]. Over the following months, clashes between security forces and protesters escalated, ultimately leading to war among dozens of factions comprising the Syrian government, opposition forces, and a collection of VEOs including Al-Qaeda and ISIS.

VEOs

Al-Qaeda and ISIS have both played a prominent role in the war in Syria, taking advantage of the chaos to expand and maneuver. While water conditions in Syria did not cause these organizations to emerge there, they gave the groups leverage. At times, these groups used access to water to gain power or to recruit. They targeted key water infrastructure as a strategic security asset and, in ISIS' case, sought to control water resources as part of the organization's broader state-building project.

Involvement of Global Powers

As the Syrian conflict has escalated, it has taken on characteristics of a broader regional war due to the involvement of actors such as Iran and Turkey. In addition, countries from outside the Middle East, including the United States and Russia, have been drawn in militarily to protect their own, sometimes competing, strategic interests in the region. Russia has been involved in the Syrian conflict for several years. For example, in 2015, it began bombing ISIS, but has also been accused of targeting opposition forces fighting the Assad regime [100]. For its part, the U.S. has also been drawn into the war. In 2017, the U.S. military conducted a missile attack on a Syrian airbase from which Syrian government planes allegedly staged a chemical weapons attack. The U.S. also has armed the YPG, Kurdish Popular Protection Forces [100]. The involvement of major powers in the Syrian war is not the direct result of water stress. It does, however, stem in part from a population's suffering from multiple woes, water stress among them. Over time, the situation has become the deadliest conflict in the world today.

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STATE-ON-STATE CONFLICT

The highest-intensity conflict is violent conflict between states using a full spectrum of weapons and means of warfare, often resulting in the overthrow or capitulation of one of the belligerents. Violent interstate conflicts could be destabilizing in regions of U.S. national security importance. History shows that the U.S. often aligns with one side, and is likely to be drawn into the conflict in some manner, particularly when one adversary is an important ally or friend.

While there are many current and recent examples of uprisings, insurgencies, and civil wars, there are few examples of true state-on-state conventional war this century; two notable exceptions that have involved the U.S. are the invasions of Afghanistan in 2001-02 and of Iraq in 2003.²

None of this century's interstate conflicts was caused solely by water stress. In fact, there is a persuasive academic argument that "water wars," by which we mean interstate conventional wars, have historically not occurred, and that water-related violence takes place only at the subnational level [102]. This view was echoed in a 2012 Intelligence Community Assessment on Global Water Security, which assessed interstate violent conflicts over water in the next 10 years to be unlikely [2].

Why aren't there water wars? Several compelling arguments explain why countries do not resort to conventional warfare to secure access to water. Understanding how increasing water stress may test these assumptions, however, is critical for contingency planning and risk mitigation moving forward.

Geography and Economy Yield Cooperation

There are geostrategic impediments to violent confrontation over water between states. An upstream state is unlikely to start a water war with a downstream neighbor since it controls the resource. A downstream state is unlikely to engage in war over water with an

Key Points

"Water Wars"—violent conventional interstate wars over access to water alone—tend not to occur.

Since upper riparians control water access, they are unlikely to engage militarily with downstream riparians over water.

Few downstream riparians have military advantage or other leverage over upstream riparians, and are therefore unlikely to engage militarily.

Warfare is likely to exacerbate the water challenges of the downstream aggressor, rather than secure its interests.

Even so, countries experience competition and heightened tensions over water—sometimes alarmingly.

Increasing water stress may test international agreements that help resolve disputes.

Water disputes are unlikely to start a conventional war, but could serve as a contributing factor that draws nations into eventual conflict.

² For purposes of this discussion, Russia's annexation of Crimea falls below the threshold for conventional state conflict.

upstream state unless it has a military advantage or other leverage. In addition, a weak upstream state would need the desire and ability to build a dam or other infrastructure that would threaten the quality or allocation of water to the more powerful downstream state [102-103]. Only a handful of the hundreds of transboundary basins in the world meet these criteria [102]. Water experts often cite this in dampening concerns over water wars [104].

Of the few basins that do meet the criteria, two notable examples warrant additional study and research: the Nile basin, where downstream Egypt is wealthier and more militarily advanced than upstream Ethiopia,

Because of geography, dependencies, and economies, states are unlikely to resort to conventional warfare in water disputes.

which is nearing completion of the Grand Ethiopian Renaissance Dam (GERD); and the Vakhsh basin in Central Asia, where Tajikistan plans to build the Rogun Dam, opposed by downstream Uzbekistan [102, 105].

Other factors may explain why neighboring countries are unlikely to go to war over shared water, namely that a water war would most likely fail to secure the strategic, economic, and shared interests of its combatants. There are many potential outcomes in which warfare would only exacerbate the water challenges of the downstream aggressor, rather than secure its interests. Because war is expensive and disruptive and water relatively cheap, it makes more economic sense for states to cooperatively share water—through joint management of resources, for example, or coordination in dam construction, water flow,

and data sharing. This secures their mutual interests [102].

Like others who have reached the same conclusion, we found that because of geography, dependencies, and economies, states are unlikely to resort to conventional warfare in water disputes. Countries tend to prefer cooperation to conflict in securing access to water [7, 106].

Instances of interstate cooperation—including the signing of water accords—outnumber instances of water-related conflicts or disagreements [106]. For example, international water agreements cover 70 percent of the world's total transboundary basin area and are becoming more common and more comprehensive, including mechanisms for joint management and dispute resolution (more below on the challenges to these agreements) [107]. Furthermore, cooperative institutions and mechanisms created by water agreements tend to be resilient over time [102].

Existing State-on-State Tensions over Water: Potential for Escalation?

Despite these two conclusions—that large-scale water wars between states tend not to occur and that cooperation is usually preferred over violence to resolve disputes—there are areas around the world today where neighboring countries experience ongoing competition and at times heightened tensions over water. We point to several examples in which states that control water—typically upstream states—use it as non-military leverage against downstream riparian neighbors, although their actions may not be overt and their motivations may not be explicit. This behavior is likely to rise in increasingly water-stressed river basins. Conversely, downstream states that do not control water have used—or threatened to use—aggressive non-military means (such as influence operations, covert sabotage, or support for non-state actors) to shape the behavior of states upstream that influence control of water access.³ Put simply, upstream

³. There is some evidence, for example, that upstream Turkey has used its ability to control water flows to pressure downstream Syria to drop its support for the Kurdistan Worker's Party (PKK), a separatist group based in Turkey, while Syria has used its support for the PKK as a bargaining chip to secure access to water. In 1987, the countries signed dual agreements in which Turkey guaranteed minimum flows and Syria agreed to end its support of the PKK; later, Syria resumed its support for the PKK as a means to pressure Turkey to fulfill its commitments.



Supporters of Jamaat-ud-Dawa sit in front of a sign and hold a placard during an anti-India protest in Lahore, March 7, 2010.

states have used water as a non-military means to pursue their security interests, while downstream states have used non-military threats to security as means to ensure water access.

We provide three examples of countries experiencing these dynamics: India and Pakistan; Ukraine and Crimea; and Egypt and Ethiopia.

Upstream states have used water as a non-military means to pursue their security interests, while downstream states have used non-military threats to security as means to ensure water access.

Leverage by Upstream States over Water-Stressed Downstream States: India and Pakistan

A recent, salient example of an upstream state's leverage of water resources over a downstream neighbor is in the Indus River Basin. The Indus River flows through India on its way to Pakistan and is a critical water resource to both countries. Tensions over this shared water resource take place within the broader relationship between the two countries, which has been historically poor, the result of multiple political and military disputes since Pakistan's independence in 1947. Both countries today possess nuclear weapons, and the U.S. and the broader international community go to great lengths to reduce tensions between them.

The 1960 Indus Waters Treaty (IWT), which has survived two wars and several standoffs and skirmishes

between India and Pakistan, is held up as an example of the resiliency of international water agreements. For more than 50 years, the IWT has remained an area of cooperation between the two adversaries. A commission has allowed the countries to coordinate the construction of irrigation and power infrastructure, to mediate disputes, and to share hydrological data [108].

The IWT has also provided a means for both countries to construct certain water canals with defensive military purposes in mind. As one analyst has noted, “The efficacy of canals as defensive infrastructure that could serve as tank ditches and hinder enemy movement was not lost on the military planners of the two countries” [108]. The Bambanwala-Riya-Branch Canal was used as a defensive fortification by Pakistan’s army in its war with India in 1965. Similarly, the 649-kilometer Indira Gandhi Canal, located on the Indian side of the border, could provide a line of defense in time of war by serving as a tank ditch [108].

Both sides have exploited the IWT to protect their respective interests. Fearing the aggregate impact on water flow, Pakistan has used the IWT to oppose Indian power and agriculture projects on technical grounds, safeguarding its own water access [108]. This access is critical, as water availability in Pakistan has “plummeted” since its founding [109]. A United Nations Development Program publication has described water scarcity as “Pakistan’s most critical development challenge,” while press reports have characterized it as “a bigger threat than terrorism” [110-111].

India, in September 2016, threatened to revoke the IWT, partly in response to Pakistan-based terror attacks on an Indian military position in Kashmir [112-113]. However, there are several reasons India is unlikely to follow through on this threat [114]. Revocation of the treaty would likely receive international condemnation and might embolden upstream China to reduce flows of the Brahmaputra River to downstream India. Reducing Indus flows to Pakistan might also be counterproductive: It could produce flooding in India or provoke the very terror groups that India believes Islamabad supports.

Upstream states have—and employ—real leverage over downstream users.

The mere fact that India would threaten to revoke a 60-year-old treaty demonstrates that upstream states have—and employ—real leverage over downstream users. The threat also calls into question the assumed resiliency of long-held water agreements by suggesting they can be used as a bargaining chip, especially where there is narrow scope for cooperation between adversarial neighbors. Whether India’s threat has discouraged Pakistan’s alleged support for militants in Kashmir remains to be seen.

Curtailing Access to Water: Ukraine and Crimea

Beyond threats and pressure, a state can physically cut off or sharply curtail a neighbor's access to water. The annexation of Crimea by Russia in March 2014 exposed the Crimean Peninsula's dependency on mainland Ukraine for water and electricity [115]. Following the annexation, the Ukrainian government blocked the North Crimean Canal, which diverts water from Ukraine's largest river, the Dnieper, to the peninsula, which relied on the canal for 85 percent of its water [116].

The water blockade has devastated agriculture, reducing irrigated land by 97 percent and forcing Crimean authorities to ban water-intensive crops, invest \$330 million in underground water pumps, and truck in water to needy districts. Water stress has been further aggravated by industrial use, saltwater intrusion of aquifers, and the alleged diversion of water supplies to Russian military forces [116-117]. The sides seem to frame matters to their

respective political advantage, with each blaming the other for the water crisis [117]. The blockade also illustrates a conundrum in Ukraine's use of water stress as a political tool short of military conflict: While the retaliatory measure seemed designed to compel an adversary to change its behavior, it risked alienating the people of the territory Ukraine seeks to reclaim [115].

Tactics Attractive to Downstream States: Egypt and Ethiopia

When states seek to disrupt or destroy upstream infrastructure that constrains their access to water, activities short of military aggression can achieve these objectives in ways potentially deniable and less risky than conventional military force. The Nile River Basin demonstrates how water stress can alter the dynamics between states sharing a basin, and that national leaders may prefer actions other than overt military force to secure water access.



Water supply reductions on the North Crimean Canal which delivers water from the Dnieper River for irrigation, near Dzhankoi, Crimea, April 25, 2014.

Despite the creation in 1999 of the Nile Basin Initiative, a “forum for consultation and coordination among the Basin States for the sustainable management and development of the shared Nile Basin water and related resources for win-win benefits,” allocation of the Nile’s waters is not equitable [133]. The basin is governed by colonial-era agreements that awarded rights to Egypt and Sudan, excluding other countries [103, 134-135]. Egypt and Sudan make up 95 percent of the basin’s irrigated area, and Egypt relies on upstream flows for 97 percent of its water needs [134-135]. As a result, Egypt has historically been protective of its water rights, including opposing construction of the upstream Grand Ethiopian Renaissance Dam (GERD), a 6,000 MW dam that will be the largest in Africa and is nearing completion [136-137].

The threat posed by the dam led Egyptian politicians in 2013 to urge then-President Morsi to halt its construction [138]. Despite Egypt’s conventional military advantage, the politicians suggested approaches other than war, such as influence operations to convince the Ethiopian press of an imminent strike, exploiting political rivalries within Ethiopia, arming rebels to destabilize the government, and even instructing intelligence operatives to sabotage the dam [138].

In the end, Morsi mainly engaged in aggressive rhetoric that Ethiopians described as “violent,” but which fell short of overt calls for conflict or military action [139-140]. Still, the episode offers two key insights. The first is that the prospect of water stress can alter the relationship between states that share a river basin. Although Egypt is wealthier and has greater military capability than Ethiopia, it has vulnerability as a downstream state. Second, the episode demonstrates that a desperate downstream state may choose aggressive actions short of armed conflict to ensure vital access to water, despite having a military advantage.

Competition and Conflict over Water

As water stress intensifies, will treaties hold up? Complex, comprehensive international water treaties are proliferating. However, such agreements vary widely in the degree to which they bind all states in a basin, manage water cooperatively, or provide mechanisms for dispute resolution. Only 13 percent of multilateral basins have a treaty that includes all states in the basin [107]. Only 25 percent of all water treaties cover the entire geography of the basin. Approximately 9 percent of water treaties cover all waters shared among two or more states, but these tend mainly to provide a framework for cooperation on issues as they arise [107].

Addressing a November 2016 UN Security Council meeting on water, peace, and security, Secretary-General Ban Ki Moon noted that only 84 of 236 shared river basins have a joint water-management body [141]. The resiliency of existing water agreements should not be assumed, particularly given projected future water stress resulting from climate variability, groundwater depletion, and patterns of water use driven by trends in population growth, migration, urbanization, and growing affluence. Indeed, studies identifying which basins are most at risk for hydro-political tensions and conflict—typically, but not exclusively, in Asia and Africa—include basins with water treaties (e.g., Indus, Lake Chad, Asi-Orontes, Ob) and without (e.g., Irrawaddy, Saigon, Han) [106, 142-144]. And, while water treaties may prevent conflict at the state level, they can increase the risk of subnational conflict if they “[embrace] poorly conceived water development plans or [impose] unmanageable costs of adjustment on local communities” [145].

Increased global water stress may alter the dynamics among countries in a shared river basin even if it does not lead to overt military conflict.

Increased global water stress may alter the dynamics among countries in a shared river basin even if it does not lead to overt military conflict. Rising future demand will give states that control water greater leverage over those that don't, while raising the stakes for desperate downstream states. The latter may consider alternatives short of overt military conflict to secure access to water necessary for their survival. Such tactics are appealing because they are less costly and more deniable than overt military action, but can still achieve strategic objectives, particularly for the weaker actors. More broadly, as water stress becomes a greater vulnerability for a growing number of states, it may be increasingly exploited in competition short of armed conflict even if it is not the original source of tension.

State-on-State Conflict and the Potential for Greater Water Stress

We find that, today, geopolitical, strategic, and economic factors make the prospect of state-on-state war involving water unlikely. The importance of water stress as a factor in conflict, however, should not be dismissed. As states experience greater water stress—due to population pressures, climate change, and migration—the potential exists for water stress to amplify existing tensions between states. The United States should be aware that a dispute over water may not start a major conventional war, but it could be a contributing factor, among other state-on-state grievances, that draws the U.S. into an eventual conflict.


Mekong River Basin

China and the Mekong River Basin: Sovereignty or Hegemony?

The Mekong River Basin, although technically not experiencing water stress on the level of other conflicts we examine, serves as a case study in how shared water resources can be sources of both cooperation and competition. The basin encompasses six countries—Cambodia, China, Laos, Myanmar, Thailand, and Vietnam—and supports a population of over 260 million [118]. Established in 1995, the Mekong River Commission (MRC) provides a platform for joint water management and cooperation in the region, but only the downstream countries—Laos, Thailand, Cambodia, and Vietnam—are members. The upstream countries—China and Myanmar—are “dialogue partners” of the commission, but have not signed the pact that established it, the Agreement on the Cooperation for the Sustainable Development of the Mekong Basin [119].

In 2015, China created its own platform for multilateral cooperation on Mekong River Basin issues, the Lancang-Mekong Cooperation (LMC) Leaders’ Meeting. China typically prefers to discuss water issues with other countries on a bilateral basis, but the LMC allows it to cooperate with Mekong basin neighbors on its own terms [120-121]. Officially, the MRC welcomed establishment of the LMC and took part in its first two meetings [122]. However, critics of the LMC view it as a Chinese effort to “marginalize” the MRC [123].

China has used both its wealth and its upstream location to secure its sovereign interests in water and development. China has access to a lot of water, controlling the headwaters of rivers like the Yangtze, the Mekong, the Brahmaputra, and the Indus. But it requires large quantities of water to support a growing economy of 1.4 billion people and its energy demands as the largest consumer of power [124]. Moreover, China’s water is unevenly distributed: Much of it is in the country’s south, while the north has 50 percent of the agricultural land and produces more than 50 percent of GDP [125]. To address this, the government plans to divert a massive volume of water from the south to the north.



In addition to constructing six of its own dams on the Mekong, China has committed billions of dollars for 14 others within the basin to import additional electricity to its “growing southern regions” [126-127]. These projects further extend China’s influence in Southeast Asia at a time when the United States and its allies want to strengthen ties in the region [128-129]. The Chinese investments have been made while the Asian Development Bank, backed by the United States and Japan, has financed “a multibillion-dollar network of all-weather roads, bridges, dams, and power lines” that enhances connectivity and development in the Lower Mekong region [130]. The United States has also backed the Lower Mekong Initiative, a partnership that encourages cooperation between the U.S. and the Mekong’s downstream nations. China views such actions as efforts to constrain its influence in the basin [128].

Analysts note that recent droughts—exacerbated by Chinese dams—underscore the downstream countries’ dependence on China [126, 131]. Brahma Chellaney describes China as a “hydro hegemon” because so many countries rely on water that originates there, and because China, with more major dams than the rest of the world combined, plans even more. Chellaney has argued that China is the biggest impediment to cooperative water management in Asia, and that “by building megadams and reservoirs in its borderlands, China is working to re-engineer the flows of major rivers that are the lifeline of [downstream] states” [132].

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CONCLUSION

Because today's international security environment is more complex and unpredictable than ever before, the United States faces new challenges to its interests, often from new places. To secure America's future, we must identify and understand these threats, their sources, and their potential ramifications, particularly in areas of strategic interest.

As the world's population grows and the impacts of a changing climate manifest, we see water stress becoming increasingly prominent as a driver of violence and conflict. Through a careful examination of hostilities in water-stressed areas over the past five years, we found that water stress directly causes civil unrest and localized violence and contributes to other conditions necessary for intra-state conflicts such as insurgencies, civil wars, and those involving VEOs. VEOs, in particular, have demonstrated the ability to exploit the conditions that water stress creates to forward their political and military goals. We also found that major wars over water do not occur among nation states, but that, for multiple reasons, the prospect of future state-on-state conflict involving water as a factor should not be dismissed. For example, with increased water stress, water could serve as a contributing factor in escalating tensions where countries share a basin. This could result in threatened use of force or, in a worst-case scenario, violent state-on-state conflict.

It is generally in the interest of the United States to curtail violence and conflict around the world. Doing so helps secure its overseas interests, both physical (citizens, embassies, military bases) and economic (businesses, trading partners, supply chains). It safeguards its partners and allies and contributes to security at home.

The understanding we gained in our analysis provides insights into where U.S. intervention,

assistance, development, and diplomacy can serve to reduce water stress as a current and future source of conflict and violence. Notably, we have observed that people are quick to hold their governments responsible and accountable for providing sufficient water resources for survival and economic prosperity. Governments have many points of intervention and control, shaping both the supply and demand sides of the water stress equation. We have found that, in many areas, water stress results not from an absolute shortage of precipitation or water, but from a failure to adequately manage the myriad inputs to and demands of the water stress equation. While individual governments have sovereign rights to make their own choices, below are some areas where the U.S. may assist with greatest impact.

Expand diplomatic efforts to prevent and mitigate conflicts among countries that share water resources and encourage adaptive and inclusive basin-wide agreements to manage transboundary water resources.

Increase engagement in the development and deployment of water management practices, technologies, and innovations. Effective methods to mitigate water stress and address its challenges, including advances in agricultural productivity and energy efficiency, should be shared.

Use grants, public-private investment, and other mechanisms to incentivize private-sector engagement to spur innovation and improve water management practices.

Develop stronger communications nodes and strategies for alerting the interagency and international community to potential water-stress conflict.

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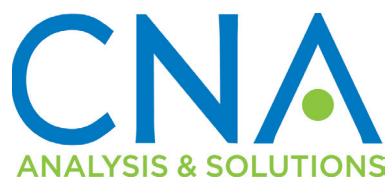
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