

A REPORT OF THE CSIS
MIDDLE EAST PROGRAM

Clear Gold

WATER AS A STRATEGIC RESOURCE IN THE MIDDLE EAST



Authors

Jon B. Alterman
Michael Dziuban

December 2010

A REPORT OF THE CSIS MIDDLE EAST PROGRAM



Clear Gold

Water as a Strategic Resource in the Middle East

December 2010

Authors

Jon B. Alterman

Michael Dziuban

ABOUT CSIS

In an era of ever-changing global opportunities and challenges, the Center for Strategic and International Studies (CSIS) provides strategic insights and practical policy solutions to decisionmakers. CSIS conducts research and analysis and develops policy initiatives that look into the future and anticipate change.

Founded by David M. Abshire and Admiral Arleigh Burke at the height of the Cold War, CSIS was dedicated to the simple but urgent goal of finding ways for America to survive as a nation and prosper as a people. Since 1962, CSIS has grown to become one of the world's preeminent public policy institutions.

Today, CSIS is a bipartisan, nonprofit organization headquartered in Washington, D.C. More than 220 full-time staff and a large network of affiliated scholars focus their expertise on defense and security; on the world's regions and the unique challenges inherent to them; and on the issues that know no boundary in an increasingly connected world.

Former U.S. senator Sam Nunn became chairman of the CSIS Board of Trustees in 1999, and John J. Hamre has led CSIS as its president and chief executive officer since 2000.

CSIS does not take specific policy positions; accordingly, all views expressed in this publication should be understood to be solely those of the author(s).

CSIS gratefully acknowledges the GE Foundation for its support of this publication. The GE Foundation did not guide the preparation of this report, nor does it bear any responsibility for its conclusions.

© 2010 by the Center for Strategic and International Studies. All rights reserved.

Cover photo credits: Paul Stephens/IRIN

Library of Congress Cataloging-in-Publication Data
Available upon request.

ISBN 978-0-89206-620-9

Center for Strategic and International Studies
1800 K Street, N.W., Washington, D.C. 20006
Tel: (202) 887-0200
Fax: (202) 775-3199
Web: www.csis.org

Contents

iv	List of Figures
v	Executive Summary
I	Background
4	Water Depletion
4	Water and Politics
7	Migration
9	Political Alienation
II	Clarifications and Applications
12	Recommendations and Conclusions
15	Endnotes
23	About the Authors

List of Figures



Page:

1	1	Total Actual Renewable Water Resources per Inhabitant
2	2	Global Desalinated Water Production
3	3	Domestic Uses of Saudi Oil
3	4	Uses of Desalinated Water in Abu Dhabi Emirate
4	5	Water Use in Yemen
13	6	Agriculture, Water, and GDP in Selected Middle Eastern Countries

Executive Summary

The real wild card for political and social unrest in the Middle East over the next 20 years is not war, terrorism, or revolution—it is water. Conventional security threats dominate public debate and government thinking, but water is the true game-changer in Middle Eastern politics.

Scholarly work on water has often focused on shared rivers as a potential cause of war between countries. But countries in the Middle East have not gone to war over their rivers, and diplomats have been successful in keeping tensions to a minimum. Instead, finite supplies of underground water within national borders pose a more immediate and strategically consequential challenge. Groundwater has fed the agriculture that many regional leaders have used to cement political loyalties. Its potential exhaustion threatens existing political balances.

Water is a fundamental part of the social contract in Middle Eastern countries. Along with subsidized food and fuel, governments provide cheap or even free water in order to ensure the consent of the governed. But when subsidized commodities have been cut in the Middle East, instability has often followed. Water's own role in prompting unrest has so far been relatively limited, but that record is unlikely to hold. Water has no substitutes, and while cheap in its natural state, water is expensive to process and transport. Future water scarcity will be much more permanent than past shortages, and the techniques governments have used in responding to past disturbances may not be enough.

The Middle East's water problem grew out of its successes. The “green revolution” that swept the Middle East in the 1980s and 1990s made it possible for countries to sustain agriculture and feed growing populations, and high levels of agricultural investment continue today. In general, however, countries have focused too much on ensuring water supply and not enough on tamping demand.

Groundwater depletion will have a range of consequences for how Middle Eastern governments function and manage relationships with the governed. Migration will be one major problem, as populations dependent on agriculture find they can no longer make a living in rural environments. Political alienation will pose another challenge. As part of a system of agricultural patronage, water use is often a point of pride among certain populations or elites, who see it as a sign of their government's favor. When groundwater runs out, it could challenge these perceptions—and the stability to which they contribute.

Preventing crisis is in part a matter of continuing to ensure adequate water supply. Investment in advanced technologies for water production, treatment, and reuse is a feasible route for some countries, particularly wealthy ones. On the demand side, countries must impose comprehensive water pricing systems and offer incentives for responsible use. In all countries, it will be crucial to change the perceptions of ordinary people about water and appropriate uses for it. If water appears to be a free resource, it will continue to be treated as an inexhaustible one.

Effective reform is within reach if governments work as much as possible within existing political and economic structures—framing water conservation in terms that citizens can understand and rewarding it with the kinds of incentives to which they are accustomed. But reform will need to happen quickly. A combination of government action and inaction has shaped the Middle East’s water problems, and only government action can prevent them from causing sudden upheaval.

“Water mismanagement has often sprung from hyperactive politics and sluggish strategy; regional governments can no longer afford either one.”

The real wild card for political and social unrest in the Middle East over the next 20 years is not war, terrorism, or revolution—it is water. Conventional security threats dominate public debate and government thinking, but water is the true game-changer in Middle Eastern politics.

It's no secret that the Middle East is a water-scarce region. Of the 15 most water-poor countries in the world, 10 are in the Middle East.¹ An additional five Middle Eastern countries are well below the United Nations water “poverty line” of 1,000 cubic meters per person per year, and two others barely surpass it.² On a world map of water scarcity, the Middle East is the largest region in which water demand outstrips supply.³

Water scarcity in the Middle East has led many observers to warn of wars over shared rivers. In fact the greater threat is not across borders but within them. Countries often have been successful

in negotiating shared access to river water; the more fundamental problems will involve sharply diminishing groundwater resources. Governments have long used water as a political tool, but as groundwater becomes scarcer—as fresh water becomes expensive or unavailable—the power and authority water has wrought will be challenged. Hence the Middle East's future may be less secure than its past and its present.

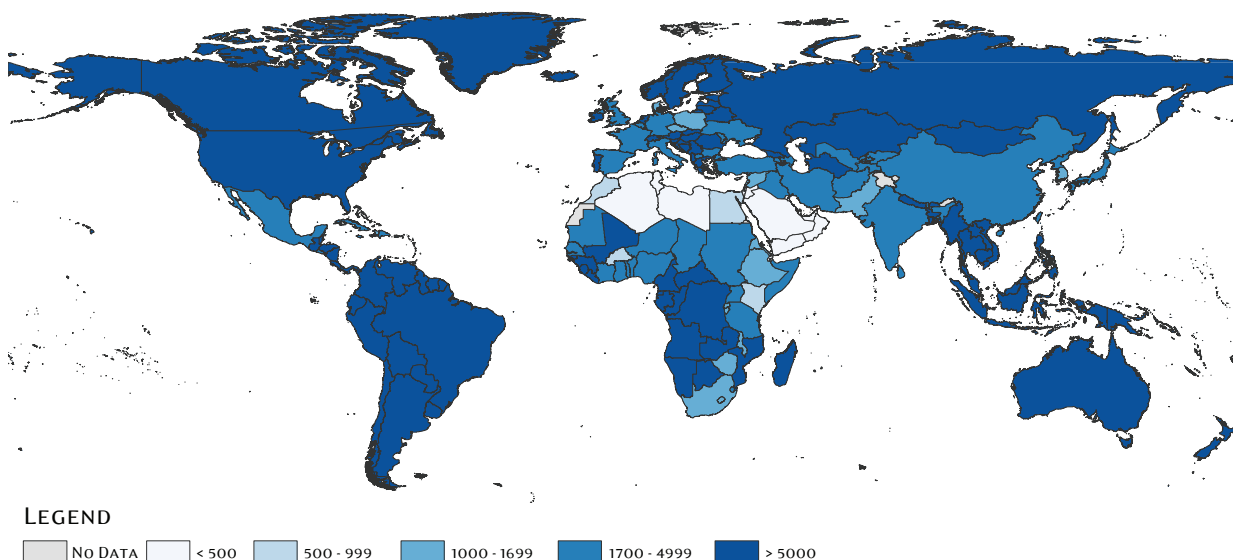
In the face of this vulnerability, policymakers must act strategically to reform groundwater use. Doing so will require a robust synthesis of political will, governance, and leadership. Water mismanagement has often sprung from hyperactive politics and sluggish strategy; regional governments can no longer afford either one.

BACKGROUND

Scholars have long understood the connection of water to issues of security. In the Middle Eastern

Figure 1: Total Actual Renewable Water Resources per Inhabitant (m³/year)
Actual renewable surface water and groundwater resources per inhabitant (in 2005)

Source of data: FAO-AQUASTAT, 2008.



“Despite an extensive ‘water wars’ literature that blossomed in the late 1980s and early 1990s, the fact remains that few states in the Middle East have fought each other over water.”

context, the focus has been on the region’s major river basins—the Jordan, the Nile, and the Tigris and Euphrates—and the argument has been straightforward: as water scarcity increases, so does the risk of violent international conflict, since nations will act to ensure sufficient access to water. If a party feels slighted or threatened, or if it simply does not get the water it wants, conflict will ensue.⁴

Reality tells a different story, however. Despite an extensive “water wars” literature that blossomed in the late 1980s and early 1990s, the fact remains that few states in the Middle East have fought each other over water. States tend to cooperate over water, as Israel and Jordan did in their 1994 agreement over the Jordan River,⁵ and countries such as Turkey, Syria, and Iraq have kept their water tensions manageable.⁶ Since it became widespread, the water wars thesis has had little predictive power in a region already prone to conflict, and it is hard to imagine a water war erupting in the Middle East in the foreseeable future.

Security scholars’ concern with international conflict over water also neglects an important fact about the Middle East: most Middle Eastern governments’ security calculations are fundamentally inward looking.⁷ In country after country, the decisions that truly matter are the ones that have to do with politics, not diplomacy. Through diplomacy, land can be won or lost, but it is through politics that power is mediated.

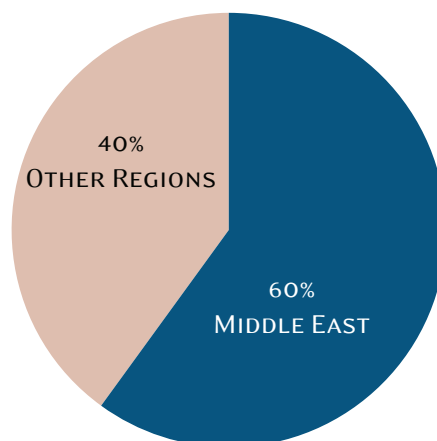
People and governments in the Middle East have used finite water supplies as a political coin for more than a half century. They have concentrated on the supply side of the water equation, providing

ever more water for thirsty populations. The regulatory part of water use, such as empowering strong water ministries to allocate scarce resources, often has been neglected. Water ministries tend to control only a fraction of the water use in their countries, and they struggle mightily to assert any control over the most egregious examples of water wastage. In many cases, water ministries have little influence over or communication with related ministries such as power, mining, or industry, and have limited access to the highest levels of political power. Generally weak players in governmental affairs, water ministries tend to have trouble crafting the right incentives to curtail waste. Too often, they and the governments they serve merely respond rather than plan.⁸

That response has been centered on the demand curve. As Middle Eastern populations became more urban in the twentieth century, municipal water systems grew apace. For wealthy countries close to sea level, desalination has been the preferred method

Figure 2: Global Desalinated Water Production

Source of data: Banque Saudi Fransi.



to meet growing water demand. The Middle East is now home to 60 percent of the world's entire desalination capacity—with Saudi Arabia and the United Arab Emirates (UAE) alone accounting for about half that amount.⁹ Each of these two countries continues to spend over \$3 billion on desalination every year. In Saudi Arabia, more than half of the country's domestic oil consumption is devoted to the linked processes of desalination and electricity generation, and demand for both is growing sharply.¹⁰ With water billed at merely 1 percent of the cost of production, it is no surprise that demand is skyrocketing along with the cost of continuing subsidies.¹¹ Even in oil-rich countries, skyrocketing demand for cheap water is threatening to outstrip governments' abilities to sustain supply growth.¹² Only a quarter of the desalinated water in the Emirate of Abu Dhabi is drunk; the rest is used to water crops and home gardens or for industry and activities like car washing.¹³ The economics of water make rising use sustainable for the consumer, at rising costs to the producer.

Desalination is only part of the story. The role of agriculture is also crucial to understanding water use in the Middle East. Rich and poor countries alike have invested at high levels to exploit underground aquifers in a quest for domestic food security and an enduring source of livelihood. This “green revolution” began in the Middle East in the 1970s and reached its peak in the 1980s and 1990s—and in some countries, the changes were immense. Through intensive irrigation, Saudi Arabia roughly tripled its area of farmland between 1980 and 1992¹⁴ and more than quadrupled its food production.¹⁵ Between 1984 and 2000, the desert kingdom spent an estimated total \$83.6 billion on agricultural development,¹⁶ helping it become the world's sixth-largest exporter of wheat.¹⁷ In the next 10 years, the kingdom expects to invest an estimated \$28 billion in additional agricultural projects.¹⁸

The scale of Saudi Arabia's agricultural investment may be unique in the Middle East, but the nature of its agricultural growth is not. In Jordan,

Figure 3: Domestic Uses of Saudi Oil

Source of data: IPS News.

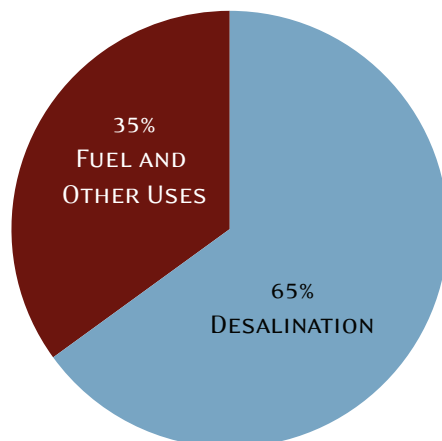


Figure 4: Uses of Desalinated Water in Abu Dhabi Emirate

Source of data: Water expert #3.

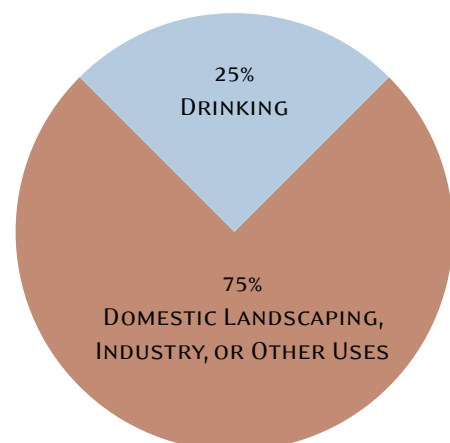
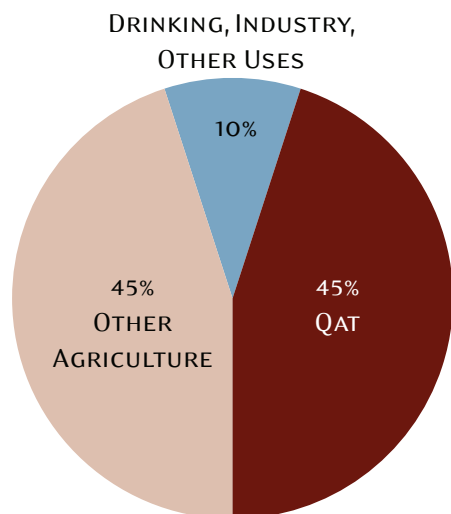


Figure 5: Water Use in Yemen

Sources of data: World Bank, *New York Times*,
FAO-AQUASTAT.



revenues for some agricultural products like vegetables increased tenfold during the 1980s and 1990s.¹⁹ This was part of an agricultural boom that combined government resettlement projects for rural tribes with cheap energy and technological advancement to develop a modern agricultural market system.²⁰ Between 1994 and 2008, Jordan's irrigated area continued to expand, registering a total additional growth of nearly 50 percent,²¹ and Jordan now exports anywhere from \$500 to \$900 million worth of food every year.²² In Yemen, irrigated land area tripled between 1970 and 2000,²³ largely because of irrigation to grow the narcotic leaf qat.²⁴ Today, agriculture is a source of livelihood for more than two-thirds of Yemen's population—with the qat industry alone accounting for about a quarter of the entire Yemeni economy and for half or more of the country's agricultural water use.²⁶ These factors will likely lead the capital city of Sana'a to the brink of total groundwater depletion in seven years or less.²⁷

The Middle East's green revolution has created a situation in which agriculture now accounts for between 65 and 90 percent of national water consumption across the region.²⁸ But much of the water that agriculture uses comes from underground aquifers that cannot be replenished.

Governments remain persuaded by the notion that the more water they provide, the more prosperous they will be. They have not made concerted efforts to curtail the wasteful practices by farmers and wealthy urban dwellers that keep water demand high. Instead, they dig new groundwater wells and build more desalination plants, led by the perception that water is an infinite resource.

A related part of this problem is that, especially when it comes to groundwater, governments have trouble maintaining and using complete information about available resources. Politicians focus on rivers and other surface resources they can see. Some governments have had success in mapping groundwater in certain areas, but too often they don't update this information or use it for fear of political backlash. Other governments avoid data altogether, assuming that they simply don't need to know about groundwater depletion, or that it can never happen. Regional governments feel constrained enough, and they are not looking for ways to make their current jobs harder.

WATER DEPLETION

Decisionmakers need to focus on the fact that groundwater is a finite resource—but that unlike other finite resources such as oil and gas, water has no substitutes. As aquifers are pumped more quickly than they can recharge, their water supply shrinks and in some cases becomes too salty to use for agriculture or drinking. This may be a gradual process in some places and a rapid one in others, but it is inevitably a difficult process to predict.²⁹ When groundwater wells dry up, they often dry up for good—and the consequences could take governments and their people by surprise.

Water and Politics

Governments in the Middle East count water provision among their strategies for building political stability and bolstering legitimacy. From

Iraq to Egypt, from Saudi Arabia to Algeria, among poor countries and rich, governments in the region provide cheap goods and services in exchange for political support. The ability to provide food, water, fuel, and electricity assures the consent of the governed. In this way, domestic service provision has become a survival strategy that both engages the public and neutralizes it.³⁰

In Jordan, for example, water and agriculture are at the heart of a complex political patronage structure where little other resource wealth exists. About a dozen powerful families control the agricultural market in Jordan, including two families of former prime ministers.³¹ Some members of these families have also held senior positions in the Ministry of Agriculture and the Agricultural Committee within Parliament.³² In the Jordan Valley, families continue to consolidate their influence by buying out the holdings of smaller farmers and relying on cheap foreign labor to plant and harvest crops.³³ In the highlands area, wealthy figures have been able to petition the government for full legal rights to the land—and all the water underneath it. As the landowners pump water and grow crops free of government intervention, they provide employment for the Jordanian Bedouins who form a large portion of the highlands farming population.³⁴

At the same time, the population of Jordan as a whole is almost 80 percent urban.³⁵ Many cities have large Palestinian populations, and large-scale municipal water projects help the government maintain service provision in an uncertain political environment. In a country where the division between Palestinians and native Jordanians is powerful and consequential, water and agriculture have become tools for keeping both sides satisfied—and for manipulating the rhetoric and reality of Jordan's national strength and destiny.³⁶

Even where other natural resources do exist, as in Saudi Arabia, water has long been significant

“In Jordan, water and agriculture are at the heart of a complex political patronage structure where little other resource wealth exists.”

for political strategy. When King Abdul Aziz Al Saud first brought geologists to the kingdom, they looked for water before they looked for oil.³⁷ When King Faisal embarked on his development plans in the 1960s, water and agriculture were part of a drive to settle Bedouin populations and imbue them with a Saudi national identity. By the time the Saudi political bureaucracy was crystallizing in the 1970s and 1980s, co-opting wealthy businessmen by offering large plots of agricultural land, modern irrigation systems, and free water had become a way for the government to cement political loyalties while oil revenues and the kingdom's regional influence grew along with its population.³⁸

Today, this strategy has led to a large system for dispensing patronage and rewards both to members of the royal family and to influential figures outside the House of Saud. The largest dairy company in the Gulf region, for example, is run by a major clan within the ruling family that the ruling coalition has long sought to distance from political affairs.³⁹ Another large dairy farm is owned by a conglomerate founded by the son of one of Saudi Arabia's late kings. The richest nonruling family in Saudi Arabia was at one point in the 1980s the kingdom's largest producer of wheat;⁴⁰ that family is now at the forefront of Saudi efforts to invest in agricultural production abroad as the government phases out wheat subsidies amid growing concerns about domestic food security.⁴¹ The government has used families like these, inside and outside the ruling coalition, to turn its evolving agricultural policy into a

“Violent riots over necessities have been all too common in the last decade. . . . Water’s role in prompting unrest has so far been relatively limited, but that record is unlikely to hold.”

reality. By the same token, it has used water and agriculture as tools for rewarding the loyalty of these families, and for ensuring that their loyalty can endure fluctuations in the kingdom’s political and economic trajectories.

Where national governments are weaker, as in Yemen, water remains tied to how people earn livelihoods in the absence of government efforts at development. Qat, the narcotic leaf that many Yemenis chew daily, is a cash crop that helps draw funds to tribal areas and facilitates the complex interactions that underlie Yemeni politics and society. Diesel subsidies allow qat growers to pump water cheaply, and a lack of robust water regulation ensures that they continue doing so.⁴² By exercising a light hand in this process, the Yemeni government is able to keep powerful tribes from causing security problems while it focuses on the threats from terrorist and secessionist movements that it considers more relevant. For the Yemeni government, water is a dependable and cheap way of eliminating one set of political threats when a host of others remain intractable.

But in a region where cuts in subsidized necessities often lead to unrest, water is not a reliable political tool. Violent riots over necessities have been all too

common in the last decade—they broke out in Iraq in 2003 and 2010, over reduced electricity supplies;⁴³ in Yemen in 2005, over lowered gas subsidies;⁴⁴ in Iran in 2007, over similar issues;⁴⁵ in Egypt in 2008, over bread shortages and rising prices.⁴⁶ Water’s role in prompting unrest has so far been relatively limited, but that record is unlikely to hold. A number of recent incidents are significant: In May 2010, Yemenis clashed over the right to drill a new groundwater well; the dispute killed two, damaged twenty homes, and took the military eight days to resolve.⁴⁷ Jordan experienced riots in the Ajloun area in 2009 over the introduction of new, more accurate water meters.⁴⁸ In Algeria, severe water shortages in 2002 caused riots in several towns that destroyed government buildings and vehicles. (The government responded by promising to send water tankers and to reopen wastewater treatment plants supplying the towns.⁴⁹) Similar incidents occurred in 2003, when towns south and east of Algiers rioted in response to both power and water shortages.⁵⁰

All these disturbances arose from popular perceptions that the state was unable to uphold the welfare responsibilities that are part of the social contract, and in all these cases, the governments had the capacity to reverse the conditions that caused the riots. But the erosion of water security would represent an irreversible shortage. Water remains a more problematic commodity than food and fuel: though cheap in its natural state, it is expensive to process and expensive to transport, especially in the quantities necessary for agriculture. Past water shortages have been temporary or small-scaled; future groundwater depletion will be massive

“Water remains a more problematic commodity than food and fuel: though cheap in its natural state, it is expensive to process and transport, especially in the quantities necessary for agriculture.”

and effectively permanent. Hence the techniques governments have used in responding to past disturbances may not be enough.

Migration

One of the immediate consequences of water scarcity will be the movement of large segments of Middle Eastern populations. As groundwater disappears in regions that rely heavily on it for agriculture and domestic supply, people with few options for obtaining water will be forced to move in search of the resource. Because groundwater depletion is permanent, people forced to migrate in search of water will have reason to believe that their governments have failed in a fundamental way, and reason to doubt the durability of any proposed solutions to the problem.

In some countries migration will occur from rural to urban areas. Jordan is one such case. The country gets over half of its water supply from underground aquifers, all of which are being pumped at a rate that far outstrips any ability they have to refill (and some aquifers have no such ability at all).⁵¹ One aquifer, in the Dhuleil area, has already become salinated to the point of being unusable, and people have had to change cropping patterns and look for other sources of drinking water.⁵² Agriculture alone accounts for about two-thirds of Jordan's water use⁵³ and is centered in the Jordan Valley and the highlands region. The highlands in particular are almost entirely rural. While the Jordan Valley uses treated wastewater for 70 percent of its irrigation needs,⁵⁴ the highlands rely mainly on groundwater. The area will not be connected to new water supply enhancement projects the Jordanian government is undertaking, such as the pipeline planned to

pump water from the Disi aquifer in the south.⁵⁵ In this state of isolation, the highlands are on a fast track to groundwater depletion.

This depletion will have potentially serious consequences. Few alternatives to agriculture exist for many residents in the highlands. When the area's groundwater supply disappears, not only will the farming economy suffer, but people with few other options for employment or livelihood will flock to Jordan's cities in search of work, shelter, and government services. This urban influx wouldn't be very threatening if it were more like the population movements Jordan has experienced previously. Flows of Iraqi refugees to Amman after the 2003 U.S. invasion, for example, were easy to control. Rich Iraqis arrived first and actually stimulated Amman's economy, dulling the effects of subsequent poorer migrants. Moreover, domestic perceptions of Iraqi refugees were easy to manipulate, as the Jordanian government had played no role in pulling them towards Amman; rather, Iraqis were foreigners, and their plight was easy to depict as the work of foreign entities. Palestinian refugees in 1948 and 1967 made up an even larger group, but were similarly easy to depict as outsiders displaced by external conflict and Zionist ambitions.

But water refugees from the highlands would be different. Responsibility for their condition would lie solely with the Jordanian government. They would not be outsiders: the majority of farm laborers in the highlands are Jordanian born, and a large group are East Bank Bedouins whom the government started settling using agriculture in the 1960s and 1970s.⁵⁶ If they migrated to the cities—where the Palestinian presence is often quite strong—they would reject treatment

“Household wells, a common site in Yemen’s capital until just the 1970s, have completely disappeared, and some of the oldest public wells in the city have also stopped functioning.”

as anything but full-blooded Jordanians. The government also might not be able to control who leaves the highlands first. The trip to Amman is much shorter and cheaper than the trip Iraqis made from Baghdad, so there is no telling which classes of people would arrive when. What is easier to discern is that migrants from the highlands would feel neglected by the government and view it as insensitive to popular needs. In short, while major population shifts have historically been easy for the Jordanian government to manipulate, those caused by water loss in the highlands could defy this trend.

Other population shifts could occur between Middle Eastern cities, and Yemen’s water situation is instructive in this regard. The capital city of Sana’a sits at nearly 2,300 meters above sea level and about 150 kilometers from the sea. Groundwater in the Sana’a basin has been so severely depleted that residents often have to rely on oil drilling equipment to extend the life of existing wells—some of which have reached depths of up to one kilometer.⁵⁷ Around the basin, the water table is falling at an estimated 4–6 meters every year, and by as many as 10–30 meters in some locations.⁵⁸ Household wells, a common sight until just the 1970s, have completely disappeared, and some of the oldest public wells in the city have also stopped functioning.⁵⁹ The city’s population is forced to rely largely on private tankers that pump water from wells far outside the city, truck it into urban areas, and dispense it at a premium. One expert has estimated that there are about 1,000 such trucks for domestic supply and perhaps an additional 1,000 for qat cultivation alone.⁶⁰

Taken together, these signs of groundwater depletion have been enough to convince many experts that Sana’a will run out of groundwater by 2017.⁶¹ With rural populations already struggling to find water—in some parts of the countryside, women and children often have to walk for hours just to find functioning wells⁶²—much of the city’s population will be forced to look toward other urban areas where water is more easily accessible. Most of Yemen’s population lives at elevations of more than a mile above sea level, making pumping desalinated drinking water prohibitively expensive. Even without pumping costs, desalination would be a heavy burden on a country with a per capita income of less than \$900 a year, and with rapidly vanishing oil resources. Meanwhile, the population of Yemen’s capital is exploding, not shrinking, creating the conditions for a major crisis.⁶³ It is not clear where people will go or where the water could come from when the wells run dry. Other Yemeni cities would have trouble absorbing such a massive influx of migrants, and neighboring Gulf countries might not have the water resources or the political will to accept them, either.

As but two examples of what could happen elsewhere in the Middle East, Yemen and Jordan suggest that water loss may pose unfamiliar challenges to governments. Major water loss would cast citizens into unfamiliar geographic and social contexts, and make them feel they have no choice but to emerge from quiet acquiescence in government policies and to participate—angrily, perhaps violently—in protesting the threat to their welfare. This shift could go beyond states’ previous experiences with demographic shifts and social unrest, because groundwater loss

will go beyond their previous experiences with resource scarcity.

Political Alienation

Groundwater's disappearance will exacerbate tensions among ethnic or national groups with particular claims to water and its benefits. Not only will these populations be forced to move in search of more water, but they will also have reason to believe that their governments have failed or even betrayed them.

Here the case of Jordan is again instructive. In the highlands region, where the population is overwhelmingly rural, wealthy East Bank families dominate the ownership of agricultural land. While some experts consider farmers in the Jordan Valley more connected to the regime than their highlands counterparts,⁶⁴ highlands landowners are unique because (unlike Jordan Valley farmers) they have retained the full legal rights to their land. Regardless of wealth and power, this group considers agriculture free of government meddling a part of its identity and a point of pride in its claims to the favor of the Jordanian monarchy. Exercising a light hand in water management in the highlands has in turn allowed the government to keep a crucial political constituency satisfied and loyal to the regime.⁶⁵ Limits on groundwater pumping do exist, but many highlands farmers avoid them by invoking political connections.⁶⁶ The fact that some farmers in the area pay nothing for water—and that they get their first 150,000 cubic meters free every year⁶⁷—makes overpumping the wells that much easier.

When groundwater disappears permanently from the highlands, the loss will challenge local

“Major water loss would cast citizens into unfamiliar geographic and social contexts, and make them feel they have no choice but to emerge from quiet acquiescence in government policies and to participate in protesting the threat to their welfare.”

elites' sense of pride in their water use, and could jeopardize King Abdullah's efforts to maintain the support of native East Bank Jordanians. Some families of Palestinian origin also have large land interests in the highlands—and play a significant role in agricultural markets⁶⁸—and this situation would only exaggerate the tension. Critics charge that King Abdullah has consistently favored East Bankers over Palestinians (who make up perhaps 60 percent of the country's population), and a highlands water crisis could mark a tangible, potentially irreversible challenge to that strategy.

When the highlands run out of groundwater, the government will have no good choices. Jordan lacks the funds and the geographical convenience to desalinate seawater for drinking, let alone pump it far inland. By the same token, it would cost the government more than it can afford to connect the highlands with water supply projects like the Disi pipeline. Without a clear, permanent solution to groundwater depletion, the highlands' population could become more vocal than ever in laying claim to water resources and the right to exploit them. With relations between national groups already more uncertain under King Abdullah than under

“In Saudi Arabia, water has been at the center of a lively debate over domestic agriculture and food security. Irrigation has at times accounted for as much as 90 percent of the kingdom’s water use.”

his father King Hussein, it may become harder to keep feelings of national pride and entitlement from spiraling into discontent.

Elsewhere, political alienation could take shape within regimes instead of among populations. In Yemen, for example, President Ali Abdullah Saleh himself hails from a tribe close to Sana’a,⁶⁹ and water loss in the area could look to his allies and rivals within the government like a political failure. The water ministry has been under the control of a single influential family since it was established,⁷⁰ and this too might create tension within the regime if other officials feel the water ministry has failed in its mission. It certainly would not help that Saleh might have to cut other ministries’ budgets to pay for a water crisis, and that Yemeni politics are steeped in the same assumptions of tribal order and quid pro quo that are held in Yemeni society generally—with often dramatic consequences. Ordinary Yemenis already fight with each other over water supplies and the right to dig wells;⁷¹ their government may be prompted to wage its own internal battles as groundwater depletion progresses.

Elsewhere, regime infighting may take an ideological tone instead of a tribal one. In Saudi Arabia, for example, water has for the past several

decades been at the center of a lively debate over domestic agriculture and food security. Thanks to an agricultural boom in the 1980s, irrigation has at times accounted for as much as 90 percent of the kingdom’s water use.⁷² Agricultural development gave voice to a group of elites who saw in irrigated agriculture an opportunity for enhancing how the state dispensed political patronage, much as their forebears had seen in resource provision the chance to cement the authority of the modern Saudi state in the first place.⁷³ For many years, the view that groundwater exploitation was a mark of patriotism and loyalty prevailed over the Saudi political elite, who rebuffed scientific and technical arguments about the finite nature of groundwater and the dangers of using it up.⁷⁴ Instead, it was arguments about food security and self-sufficiency that got the most attention—much as claims about technology’s power to forge a modern Saudi nation and citizenry had been given voice in the 1960s with King Faisal’s development plans.⁷⁵

But since the mid-1990s, the signs of groundwater depletion have become all too clear. One aquifer under Riyadh has become too deep to pump,⁷⁶ and the kingdom continues to use groundwater for large-scale agricultural projects—such as the world’s largest dairy farm, where 2,300 gallons of water or more are needed to produce a gallon of milk.⁷⁷ Overall, the kingdom now uses as much as 20 billion cubic meters of nonrenewable groundwater every year for agriculture—the equivalent of almost three months worth of water crashing over Niagara Falls.⁷⁸ As these abuses of groundwater have become clearer, the government has begun to respond. As early as 1993, it cut many of the subsidies for wheat cultivation and

“What the examples of Jordan, Yemen, and Saudi Arabia reveal is that groundwater depletion could threaten the way regimes manage themselves in addition to the way they manage their populations.”

ordered a halt to the export of fodder crops.⁷⁹ Since then, food imports have increasingly been used to complement domestic production,⁸⁰ and in 2008 the Saudi government pledged to phase out domestic wheat production entirely by 2016.⁸¹ At the same time, groundwater use continues at an alarming rate, and some farmers have merely switched to planting fodder crops that require anywhere from 4 to 16 times the amount of water that wheat does.⁸² Clearly, the old champions of domestic agriculture still hold some sway with the king. But with the lines between the two camps more blurred than ever, the stakes of groundwater loss are higher than before. As Saudi groundwater continues to disappear, the old proagriculture guard could fear the end of its influence over senior officials.

Such fears would not be unfounded: without groundwater, the kingdom's only option at home would be to pump desalinated water into crops that are far from the sea, and that contribute only 3 percent of the country's GDP.⁸³ In light of this, and with desalination for domestic consumption already straining the country's energy and electricity infrastructures,⁸⁴ it would be hard for proagriculture elites to continue making a convincing argument. They may increasingly vie for influence over Saudi efforts to invest in agriculture abroad, but the current paradigm of agricultural patronage will continue only with difficulty. Many of the kingdom's foreign agricultural investments are being made in volatile countries that lack the security to feed their own populations,⁸⁵ and the practice will only become more controversial on the international scene as investment increases. In such an uncertain and sensitive context, using agriculture to sustain

feelings of Saudi political loyalty could prove challenging.

What the examples of Jordan, Yemen, and Saudi Arabia reveal is that groundwater depletion could threaten the way regimes manage themselves in addition to the way they manage their populations. State patronage is a two-sided coin: on one side, governments manage their own elites; on the other side, they reward and punish ordinary citizens. The tools used are largely consistent between the two sides—so when a tool like water suddenly becomes unavailable, both sides stand to suffer. Water loss could defy popular expectations of the services governments are supposed to provide, as well as the quantity and quality of those services. It could also defy regimes' expectations of their own internal political dynamics—who holds favor with heads of state, who doesn't, and how elites build and exercise influence within the top echelons of power. Governments avoid regulating water use to win the support of important groups and individuals, but as countries use up their groundwater this calculation could end up causing instability rather than preventing it. Groundwater loss therefore constitutes a challenge to politics as usual in the Middle East, an attack on a pillar of state control. The game of survival is one that regimes are accustomed to playing with water as well as oil, food, and electricity—but the loss of water may make the game hard to play at all.

CLARIFICATIONS AND APPLICATIONS

In one way, it is tempting to assume that the future will not be this dramatic. The Middle East is already all too familiar with water scarcity, and yet relative political stability has continued to reign—so it's perhaps hard to see how groundwater loss

“Drought is a meteorological phenomenon, brought on by weather patterns and climate change . . . and the government can clearly point fingers away from itself. Under a groundwater loss scenario . . . government policies play a central role.”

should have unprecedented effects. Syria would be the easiest example to cite in making the case for groundwater loss as just another kind of water scarcity. Several years of drought in the country have displaced hundreds of thousands of people from the northeastern part of the country. Yet even close observers have trouble distinguishing any serious political disruptions caused by the drought (though some believe such effects are present and simply well hidden).⁸⁶

It is worth noting, however, that Syria's drought is a meteorological phenomenon, brought on by weather patterns and climate change. Conditions may change, and the government can clearly point fingers away from itself. Under a groundwater loss scenario, the loss is often permanent, and government policies play a central role. In these circumstances, it may be harder to prevent discontent from emerging within societies and regimes alike.

In addition, surface water is still relevant to the equation of domestic governance. Egypt's 80 million people principally rely on the Nile River rather than groundwater for their food and fodder, and Egyptian governments have used control of

Nile water as a political tool since the Pharaohs. Yet as Nile water becomes more contaminated, its use more intensive within Egypt, and its allotment among basin nations more contentious, it may prove harder to wield this tool as skillfully into the future. Groundwater is important for domestic stability, but rivers could become similarly crucial even if they do not spark international conflict.

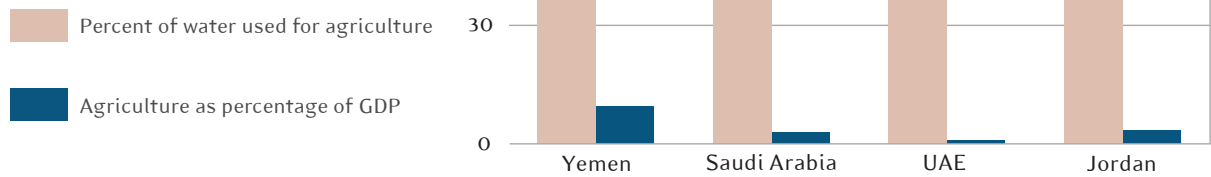
RECOMMENDATIONS AND CONCLUSIONS

Water scarcity will be important to every country in the Middle East, though it will matter in different countries in different ways. For every country, however, a combination of government action and inaction shaped existing water problems; and only government action can prevent the most negative political consequences.

On the supply side, governments trying to sustain agriculture need to investigate using treated wastewater for irrigation in order to extend the life of groundwater resources. Jordan has already had marked success on this front—about 70 percent of irrigation in the Jordan Valley now uses treated wastewater—and the UAE has implemented a similar change for public landscaping plots in Abu Dhabi. Using wastewater in these ways requires significant investment in sewage networks and treatment technologies that some countries may not be able to afford on their own. Yet many in the policy community consider treated wastewater a cutting-edge option for agriculture, and the examples of Jordan and the UAE suggest that the proper combination of investment and government will be within the reach of rich and poor countries alike.⁸⁷

Figure 6: Agriculture, Water, and GDP in Selected Middle Eastern Countries

Sources of data: FAO-AQUASTAT, CIA World Factbook.



Rich countries have more options for enhancing water supply, but the energy they have for desalination and water treatment is by no means infinite. Desalination fed by oil and natural gas will remain a mainstay, but countries would do well to consider alternative methods. Nuclear power production in particular creates a large amount of waste heat that can outpace the drop in electricity demand that occurs in many arid countries in the wintertime. This heat would be sufficient to fire desalination plants year-round without the need for additional energy, and could make the link between energy production and water production much more efficient.⁸⁸ For countries whose need to provide energy will increasingly strain their ability to provide water, nuclear desalination could be an investment in the security of both of these resources and their political value.

Still, there is no way that supply can continue to grow indefinitely. Some constraints will have to be placed on the demand side. One aspect of such a change is pricing. Current patterns of water use accurately reflect the fact that water is free or nearly so, and its supplies are unlimited. Without some sort of water tariff that at least covers the economic cost of producing water—and more ideally covers the social cost of using water—it is hard to imagine that patterns of use will change much. Countries have had some success reforming water tariffs on a local level, but applying uniform tariff systems nationwide, especially across various agricultural areas, is critical. Tariff systems also have to impose decisive penalties for exceeding a certain level of water use,

and government authorities have to be equally stringent in collecting bills and fines.⁸⁹ In addition to penalties, governments could think about providing financial bonuses to individuals and companies who show promise of responsible water use and develop solid track records of conservation.⁹⁰ Ultimately, structuring reward and punishment around resource provision is an ingrained part of politics in many Middle Eastern countries, and integrating positive incentives with more robust water tariffs could channel this established way of thinking into real water conservation.

In concert with a tariff scheme, countries could conserve huge amounts of water by using advanced technologies for water metering. “Smart meters,” which measure consumption and relay the information to a central body for monitoring and pricing, can help government authorities see how much water is being used and where, and serve as the foundation for enforcing a more robust water tariff. The UAE, which has one of the highest rates of water consumption in the world, is about two years away from having all of Abu Dhabi covered by smart meters, and about three or four years from reforming water tariffs based on the metering scheme.⁹¹ As other countries in the Middle East think about how to confront their water challenges, Abu Dhabi’s efforts could serve as a powerful example. Many countries have the money to make such investments feasible and worthwhile, and poorer ones could perhaps make a case for donor investment to help cover the costs. For governments steeped in the view that

technological advancement and control of the natural environment are hallmarks of the modern state,⁹² advanced water conservation technologies could enhance domestic security and narratives of national progress along with water supply itself.

Reforming the way agriculture functions within national economies is a necessary complement to demand-side reforms. In many countries, agriculture makes a minor contribution to national wealth,⁹³ even though it uses well over half of national water supplies. Prices of agricultural goods often do not reflect the amount of water required to grow them, so producers simply water, plant, and harvest as much as they can in order to maximize profits. Restructuring agricultural markets so that prices and tariffs reflect the water requirements of various crops could encourage farmers to tailor their water use to the quantities of crops the market requires, rather than the quantities they want to produce. When combined with robust water tariffs, such a shift could help maximize the value of agriculture while minimizing its water input.⁹⁴ If water is to be used for farming, the returns on crops must be high enough to justify that use and contribute substantially to national wealth.

For some countries, the question of water demand for agriculture may lead to much starker conclusions about what it makes sense to use water for. Pouring upwards of 90 percent of a finite resource into transient goods such as vegetables and landscaping—as many Gulf countries do—is simply unsustainable. Future agriculture in the region will need to move to greenhouses, and much will need to move out of the region altogether.⁹⁵ Changing the way ordinary

people think about water will also be vital to generating consistent water savings and helping countries even begin to keep pace with growing populations. If water is treated as a free resource, it will continue to be treated as an inexhaustible one.

These and other reforms will need to happen quickly. The Middle East is moving rapidly towards total depletion of its groundwater resources. The consequences could be unlike anything the region has seen previously, as water loss poses a new and unfamiliar challenge. It is a challenge governments have been quick to bring about and one they must be equally quick to protect themselves against.

It's wrong to assume that many Middle Eastern countries are, institutionally, not yet ripe for water reform. Certainly any reform has certain preconditions—accountability, transparency, mutual trust between rulers and subjects—that are often absent in the Middle East. Efforts to encourage water conservation and stave off political instability may encounter the frustrating reality that politics seem to need fundamental restructuring before true conservation measures can take hold.

But effective reform is still within reach if governments work as much as possible within existing political and economic structures—framing water conservation in terms that citizens can understand and rewarding it with the kinds of incentives to which they are accustomed. Innovation will be critical, but new solutions must employ the logic of existing political and social arrangements. There is no time to wait.

Endnotes

¹The ranking is by per capita availability of renewable water resources. See “EarthTrends: Searchable Database,” World Resources Institute, 2007, accessed May 4, 2010, http://earthtrends.wri.org/searchable_db/index.php?action=select_theme&theme=2. For details on the UN definition of water scarcity, see FAO (Food and Agriculture Organization of the United Nations), “Review of World Water Resources by Country,” Water Reports 23 (2003), 21, <ftp://ftp.fao.org/agl/aglw/docs/wr23e.pdf>.

² Ibid.

³ Jeannie Sowers and Chris Toensing, “Running Dry,” *Middle East Report* 40, no. 1 (Spring 2010): 3.

⁴ A full list of works on Middle East “water wars” is too extensive for inclusion here, but the following are representative: Thomas Naff, “Conflict and Water Use in the Middle East,” in *Water in the Arab World: Perspectives and Prognoses*, ed. Peter Rogers and Peter Lydon (Cambridge, MA: Harvard University Press, 1994); Michael Klare, *Resource Wars: The New Landscape of Global Conflict* (New York: Metropolitan Books, 2001); Ewan W. Anderson, “Water: The Next Strategic Resource,” in *The Politics of Scarcity*, ed. Joyce R. Starr and Daniel C. Stoll (Boulder, CO: Westview Press, 1988); Hussein A. Amery, “Water Wars in the Middle East: A Looming Threat,” *Geographical Journal* 168, no. 4 (December 2002): 313-323; Sandra L. Postel and Aaron T. Wolf, “Dehydrating Conflict,” *Foreign Policy* (September/October 2001): 60-67; Peter H. Gleick, “Water and Conflict: Fresh Water Resources and International Security,” *International Security* 18, no. 1 (Summer 1993): 79-112.

⁵ For an explanation of the 1994 agreement and its specific provisions, see Munther Haddadin, “Learning to Share,” *Harvard International Law Review* 17, no. 3 (Summer 1995): 22-25.

⁶ Syria and Iraq claim that Turkey has used dams to appropriate more than its share of the Tigris and Euphrates Rivers. The issue has come before the United Nations and the Organization of the Islamic Conference, but the three countries have also started to cooperate on initiatives such as forming an institute to survey the region’s available water and recommend policies for all three countries. See Zeynep Gurcanli, “Turkey-Iraq-Syria to Form a Water Institution,” *Hürriyet*, March 25, 2010, <http://www.hurriyet.com.tr/english/turkey/8447636.asp?gid=231&sz=47722>.

⁷ Most work treating water and security directly has taken a limited view of the domestic arena in favor of treating international dynamics. See, for example, Nevelina I. Pachova, Mikiyasu Nakayama, and Libor Jansky, eds., *International Water Security: Domestic Threats and Opportunities* (New York: United Nations University Press, 2008). For a representative sample of other work treating environment and national security, see the following: Nils Petter Gleditsch, ed., *Conflict and the Environment* (Boston: Kluwer Academic Publishers, 1996); Thomas Homer-Dixon and Jessica Blitt, eds., *Ecoviolence: Links Among Population, Environment, and Security* (Lanham, MD: Rowman and Littlefield, 1998); Miriam Lowi and Brian R. Shaw, eds., *Environment and Security: Discourses and Practices* (New York: St. Martin’s Press, 2000); Sean M. Lynn-Jones and Steven E. Miller, eds., *Global Dangers: Changing Dimensions of International Security* (Cambridge, MA: MIT Press, 1995).

8 One expert made this observation in the context of Yemen. Another expert in Jordan painted that government's approach to water supply in a similar light, calling it the "Hail Mary" approach. Jordanian water supply projects like the Disi Conveyance Project and the Red Sea–Dead Sea Canal are time- and capital-intensive, but really serve only the tactical goal of providing more water rather than the strategic one of balancing supply and demand.

9 See John Sfakianiakos, Turki A. Al Hugail, and Daliah Merzaban, "Full Steam Ahead: Saudi Power, Water Sectors Occupy Centre Stage as Demand Soars," Banque Saudi Fransi, Saudi Arabia Sector Analysis, March 14, 2010, 7, <http://www.alfransi.com.sa/en/general/download/file/466>; "UAE Spends Dh11.8 Billion on Desalination," *Emirates Business* 24/7, August 8, 2010, <http://www.emirates247.com/news/emirates/uae-spends-dh11-8-billion-on-desalination-2010-08-08-1.276189>.

10 Meena Janardhan, "GULF: Search On for Green Options to Forestall Water Shortage," *IPS News*, May 25, 2010, <http://ipsnews.net/news.asp?idnews=51570>.

11 Paul Handley, "Saudi Subsidies Incur Huge Costs, Threaten Oil Exports," Middle East Online, October 4, 2010, <http://www.middle-east-online.com/english/?id=41715>.

12 This is particularly true given experts' assertions that desalination technology is not set to provide economies of scale—the cost of desalinating water will continue to depend on energy prices and not on technological advancement. Interviews with experts #1 and #2, September 26–27, 2010. The water experts consulted for this report are cited by number because many were willing to speak with CSIS only on condition that their names not be used. The experts are scholars, government and private sector officials based in a variety of Middle Eastern countries.

13 Interview with water expert #3, March 16, 2010.

14 Elie Elhadj, "Camels Don't Fly, Deserts Don't Bloom: An Assessment of Saudi Arabia's Experiment in Desert Agriculture" (Occasional Paper No. 48, Water Issues Study Group, SOAS/King's College London, May 2004, 33).

15 World Bank, World Development Indicators, <http://data.worldbank.org/data-catalog/world-development-indicators>.

16 Elhadj, p. 17.

17 Toby Jones, *Desert Kingdom: How Oil and Water Forged Modern Saudi Arabia* (Cambridge, MA: Harvard University Press, 2010), 5.

18 Thomas W. Lippman, "Saudi Arabia's Quest for 'Food Security,'" *Middle East Policy* 17, no. 1 (Spring 2010): 95.

19 Jean-Philippe Venot and François Molle, "Groundwater Depletion in the Jordan Highlands: Can Pricing Policies Regulate Irrigation Water Use?" *Water Resources Management* 22, no. 12 (2008): 1928.

20 Ibid.

- 21 “Crops Statistics,” Hashemite Kingdom of Jordan, Department of Statistics, accessed November 21, 2010, http://www.dos.gov.jo/agr/agr_e/index.htm.
- 22 “Merchandise Trade—Jordan (Economic Territory),” Jordan’s Trade and Investment Information System, accessed November 21, 2010, <http://jotiis.dos.gov.jo:7001/JoTIIS/ControllerServlet>
- 23 World Bank, *Economic Growth in the Republic of Yemen: Sources, Constraints, and Potentials* (Washington, DC: World Bank, 2002), 26.
- 24 Marta Colburn, *The Republic of Yemen: Development Challenges in the 21st Century* (London: Catholic Institute for International Relations, 2002), 52; Nasser Arrabyee, “Qat Chewing Spreading Rapidly in Yemen,” *Gulf News*, June 16, 2002, <http://gulfnews.com/news/gulf/uae/general/qat-chewing-spreading-rapidly-in-yemen-1.390842>.
- 25 FAO (Food and Agriculture Organization of the United Nations) Aquastat, “Yemen,” in *Irrigation in the Middle East in Figures: Aquastat Survey 2008*, 392, <ftp://ftp.fao.org/docrep/fao/012/i0936e/i0936e00.pdf>; Michael Horton, “Yemen’s Dangerous Addiction to Qat,” Jamestown Foundation, *Terrorism Monitor* 8, no. 15 (April 17, 2010), [http://www.jamestown.org/programs/gta/single/?tx_ttnews\[tt_news\]=36271&cHash=42886c2cff](http://www.jamestown.org/programs/gta/single/?tx_ttnews[tt_news]=36271&cHash=42886c2cff).
- 26 The estimate of Yemen’s water consumption for qat production is derived from sources stating that over half of the country’s total water supply goes to irrigate qat, while the Sana’a basin itself uses about 50 percent of its irrigation water for qat alone. See Robert F. Worth, “Thirsty Plant Dries Out Yemen,” *New York Times*, October 31, 2009, <http://www.nytimes.com/2009/11/01/world/middleeast/01yemen.html>; Horton, “Yemen’s Dangerous Addiction”; World Bank, *Shaping the Future of Water for Agriculture: A Sourcebook for Investment in Agricultural Water Management* (Washington, DC: World Bank, 2005), 170.
- 27 For the source of this estimate and a more detailed discussion of the situation in Sana’a, see the subsection on migration below.
- 28 See, for example, FAO Aquastat, “Jordan,” in *Irrigation in the Middle East in Figures: Aquastat Survey 2008*, 238, http://www.fao.org/nr/water/aquastat/countries/jordan/jordan_cp.pdf; FAO Aquastat, “Yemen,” 394.
- 29 These statements are based on a series of phone conversations and in-person interviews with water experts #4, #5, #6, and #7 in March and April 2010. For additional but related aspects of groundwater depletion, see M. R. Llamas and E. Custodio, “Intensive Use of Groundwater: A New Situation Which Demands Proactive Action,” in *Intensive Use of Groundwater: Challenges and Opportunities*, ed. Ramón Llamas and Emilio Custodio (Lisse, Netherlands: A. A. Balkema, 2003), 21.
- 30 This argument is synthesized from a range of work covering authoritarianism, which generates and preserves political apathy through distinct political methods and “mentalities” rather than ideologies; patrimonialism, which uses patronage and service provision to accomplish authoritarianism’s demobilizing aims; rentierism, which involves the use of wealth derived from natural resources (as well as foreign aid and remittances) to generate political loyalty or apathy; and corporatism, which turns ministries focused on economic and domestic issues into power centers the head of state can co-opt to hedge against political discontent. See Juan J. Linz, *Totalitarian and Authoritarian Regimes* (Boulder, CO: Lynne Rienner, 2000), 162, 176; Hazem Beblawi, “The Rentier State in the Arab World,” in *The Arab*

State, ed. Giacomo Luciani (London: Routledge, 1990), 85-98; Abdulkhaleq Abdulla, *The Arab Gulf States: Old Approaches and New Realities*, The Emirates Occasional Papers no. 40 (Abu Dhabi: Emirates Centre for Strategic Studies and Research, 2000); Anne Louise Aartun, "The Political Economy of the United Arab Emirates: An Analysis of the UAE as an Oil Rentier State" (master's thesis, University of Oslo, 2002); Stephen J. King, "Sustaining Authoritarianism in the Middle East and North Africa," *Political Science Quarterly* 122, no. 3 (2007): 433-59; Stephen J. King, *The New Authoritarianism in the Middle East and North Africa* (Bloomington: Indiana University Press, 2009); Thomas Richter and Christian Steiner, "Politics, Economics and Tourism Development in Egypt: Insights into the Sectoral Transformations of a Neopatrimonial Rentier State," *Third World Quarterly* 29, no. 5 (2008): 939-59; Eva Bellin, "The Robustness of Authoritarianism in the Middle East: Exceptionalism in Comparative Perspective," *Comparative Politics* 36, no. 2 (January 2004): 139-57; Eva Bellin, "Coercive Institutions and Coercive Leaders," in *Authoritarianism in the Middle East: Regimes and Resistance*, ed. Marsha Pripstein Posusney and Michele Penner Angrist (Boulder, CO: Lynne Rienner, 2005); Oliver Schlumberger, "Rents, Reform, and Authoritarianism in the Middle East" (paper presented to the "Transforming Authoritarian Rentier Economies" workshop (Bonn, Germany, September 22-23, 2005); Amos Perlmutter, *Modern Authoritarianism: A Comparative Institutional Analysis* (New Haven: Yale University Press, 1981).

31 Interview with water expert #5, March 17, 2010.

32 See Khetam Malkawi, "Agriculture Committee Members Resign," *Jordan Times*, March 26, 2009, <http://www.jordantimes.com/?news=15353>; Hana Namrouqa, "State-owned Forest Areas Will Never Be Offered for Sale," *Jordan Times*, July 27, 2010, <http://www.jordantimes.com/index.php?news=28673>.

33 Mark Zeitoun, "The Political Economy of Water Demand Management in Yemen and Jordan: A Synthesis of Findings," WADImena Water Demand Management Research Series, October 2009, 29-30, http://www.uea.ac.uk/polopoly_fs/1.147019!Zeitoun_PE_WDM_Yemen_and_Jordan.pdf.

34 Phone conversation with water expert #5, April 22, 2010.

35 "Jordan," CIA World Factbook, last modified November 17, 2010, <https://www.cia.gov/library/publications/the-world-factbook/geos/jo.html>.

36 Phone conversation with water expert #5, April 22, 2010. Analysis in this paragraph is also derived from interviews with several former ministers of water in Jordan and other experts, who highlighted the tribal politicking attached to water and the sense of national pride Jordanians feel in connection with agriculture and water use.

37 Interview with water expert #4, March 20, 2010.

38 For discussions of King Faisal and the agricultural boom in Saudi Arabia, see Jones, *Desert Kingdom*, 79-83, 228-33.

39 Simon Henderson, "After King Abdullah: Succession in Saudi Arabia," Washington Institute for Near East Policy, *Policy Focus* #96, August 2009, <http://www.washingtoninstitute.org/pubPDFs/PolicyFocus96.pdf>; "About Almarai," AlMarai, accessed November 23, 2010, <http://www.almarai.com/main.html#/en/About%20Almarai>.

40 Elhadj, “Camels Don’t Fly,” 35.

41 “Saudi’s Tabuk Signs Deals for Food Investment Abroad,” Reuters, May 23, 2009, <http://www.reuters.com/article/idUSLN3154520090523>.

42 For information on qat and Yemen’s water crisis, see Ulf Laessing, “Yemen’s Water Crisis Eclipses al Qaeda Threat,” Reuters, February 17, 2010, <http://www.reuters.com/article/idUSTRE61G21P20100217>. For general information about qat, see Horton, “Yemen’s Dangerous Addiction.”

43 Richard A. Oppel and Robert F. Worth, “After the War: Energy; Riots Continue over Fuel Crisis in Iraq’s South,” *New York Times*, August 11, 2003, <http://www.nytimes.com/2003/08/11/world/after-the-war-energy-riots-continue-over-fuel-crisis-in-iraq-s-south.html>.

44 Laessing, “Yemen’s Water Crisis.”

45 Nasser Karimi, “Iranians Riot over Gas Limits,” *Detroit News*, June 28, 2007, <http://www.detnews.com>.

46 Mohamed El-Sayed, “Memories of 1977,” *Al-Ahram Weekly*, January 24–30, 2008, <http://weekly.ahram.org.eg/2008/881/eg5.htm>.

47 Mohammed Ghobari, “Two Dead after Yemenis Clash over Water Rights,” Reuters, May 14, 2010, <http://www.reuters.com/article/idUSTRE64D4YQ20100514>.

48 Conversation with water expert #5, March 17, 2010.

49 “Worsening Water Shortage Prompts Riots in Algeria,” Agence France-Presse, June 6, 2002, <http://www.afp.com/afpcom/en>.

50 Sarah Lloyd, “Power and Water Shortages Lead to Riots in Algeria,” *World Markets Analysis*, July 14, 2003, <http://www.ihsglobalinsight.com/>.

51 See Ross Hagan, “Strategic Reform and Management of Jordan’s Water Sector” (unpublished paper, March 20, 2008), 4; FAO Aquastat, “Jordan,” 237, 239.

52 FAO Aquastat, “Jordan,” 237.

53 Ibid., 238.

54 Interview with water expert #8, March 17, 2010.

55 Hagan, “Strategic Reform,” 31.

56 For statistics on the composition of Jordan’s farming population, see “Agricultural Census 2007,” Hashemite Kingdom of Jordan, Department of Statistics (DOS), accessed November 21, 2010, http://www.dos.gov.jo/agr/agr_e/index.htm. Information about Bedouin farmers is derived from Venot and Molle, “Groundwater Depletion,” 1928.

57 Email communication with water expert #9, August 25, 2010.

58 Phone conversation with water expert #9, August 25, 2010.

59 Phone conversation with water expert #10, August 26, 2010.

60 Email correspondence with water expert #9, August 30, 2010.

61 “Yemen: Capital City Faces 2017 Water Crunch,” Global Policy Forum, March 23, 2010, <http://www.globalpolicy.org/security-council/dark-side-of-natural-resources/water-in-conflict/48873.html>. This is a World Bank estimate. Others have cited 2015 as the turning point; see “Water Woes Threaten Yemen’s Anti-Qaeda Drive,” *Al-Arabiya*, January 24, 2010, <http://www.alarabiya.net/articles/2010/01/24/98268.html>. The Carnegie Endowment for International Peace has asserted that “Sanaa will be the first capital in modern history to run dry.” Christopher Boucek, “The Resurgence of Al-Qaeda in the Arabian Peninsula,” Carnegie Middle East Center, Carnegie Endowment for International Peace, November 19, 2009, <http://www.carnegie-mec.org/events/?fa=1478&lang=en>.

62 Thomas L. Friedman, “Postcard from Yemen,” *New York Times*, February 6, 2010, <http://www.nytimes.com/2010/02/07/opinion/07friedman.html>.

63 IRIN News, “Sana’a Running Out of Water with No Plan to Save It,” Global Urbanist. March 23, 2010, <http://globalurbanist.com/2010/03/23/sana%27a-running-out-of-water-with-no-plan-to-save-it.aspx>.

64 See, for example, Zeitoun, “Political Economy,” 34.

65 Phone conversation with water expert #5, April 22, 2010.

66 Zeitoun, “Political Economy,” 34.

67 Email communication with water expert #5, September 25, 2010.

68 Email communication with water expert #5, November 10, 2010.

69 Saleh’s tribe is the Sanhan, part of the larger Hashid tribal confederation. See Victoria Clark, *Yemen: Dancing on the Heads of Snakes* (New Haven: Yale University Press, 2010), 280; Paul Dresch, *Tribes, Government and History in Yemen* (Oxford: Clarendon Press, 1993), 25.

70 Two members of the al-Iryani family have held the water ministry since it was established in 2003. The Iryanis are best known for Abdulrahman al-Iryani, who served as president of North Yemen from 1967 to 1974, as well as for Abdulkarim al-Iryani, who was an influential prime minister under President Saleh and a Yemeni ambassador to the United States. See “Water Minister Reveals Protectorates Extending Plan in Yemen,” *Yemen News Agency*, May 20, 2008, <http://www.sabanews.net/en/>; J. E. Peterson, “Tribes and Politics in Yemen,” Arabian Peninsula Background Note, no. APBN-007, December 2008, 6, http://www.jepeterson.net/sitebuildercontent/sitebuilderfiles/APBN-007_Tribes_and_Politics_in_Yemen.pdf; “Yemen: Environment Minister Says 70,000 Wells Run out of Water,” *BBC Monitoring*, January 19, 2005, <http://www.monitor.bbc.co.uk/>; “Abdul-Rahman al-Iryani,” *New York Times*, March 17, 1998, <http://www.nytimes.com/1998/03/17/world/abdul-rahman-al-iryani-ex-yemen-president-89.html>; “ESCWA Water Management Leader Appointed Minister of Water and Environment of Yemen,” *MENA Business Reports*, May 20, 2003, <http://www.menareport.com/en/business/>.

71 Some disputes over water, such as one that occurred in a Yemeni village in May 2010, have involved death and destruction of property, and have required the intervention of security forces. See Ghobari, “Two Dead after Yemenis Clash.”

72 FAO Aquastat, “Saudi Arabia,” in *Irrigation in the Middle East in Figures: Aquastat Survey 2008*, 331, http://www.fao.org/nr/water/aquastat/countries/saudi_arabia/saudiarabia_cp.pdf; interview with water expert #4.

73 Jones, *Desert Kingdom*, 232–33, 237.

74 Interview with water expert #3, March 20, 2010.

75 Jones, *Desert Kingdom*, 13–15, 61–63, 229–32.

76 Interview with water expert #4, March 20, 2010.

77 Authors’ calculations based on data from A. Y. Hoekstra and A. K. Chapagain, *Globalization of Water: Sharing the Planet’s Freshwater Resources* (Oxford: Blackwell Publishing, 2008). Depending on the type of milk used to make this measurement, the water requirement may be upwards of 3,000 or 4,000 gallons for every gallon of milk.

78 Authors’ calculations based on an interview with water experts #4 and #11 and “Niagara Falls Geology Facts and Figures,” Niagara Parks Media Center, <http://www.niagaraparks.com/media/geology-facts-figures.html>.

79 Email communication with water expert #11, October 11, 2010.

80 Ibid.

81 Andrew Rice, “Is There Such a Thing as Agro-Imperialism?” *New York Times*, November 16, 2009, http://www.nytimes.com/2009/11/22/magazine/22land-t.html?_r=1&pagewanted=1.

82 Meeting with water expert #4, March 20, 2010; email communication with water expert #12, September 17, 2010.

83 “Saudi Arabia,” CIA World Factbook, last modified November 9, 2010, <https://www.cia.gov/library/publications/the-world-factbook/geos/sa.html>.

84 Indeed, some Saudi officials are concerned that electricity subsidies are too high, straining gas supplies and creating gratuitous domestic demand for crude oil at a time when international demand (especially from Asia) is still set to rise. See Gala Riani, “Saudi Arabia to Raise Non-Household Electricity Tariffs,” *Global Insight*, June 7, 2010, <http://www.ihsglobalinsight.com/>; “KSA Prepares to Scale Back Electricity Subsidies,” *Utilities-ME.com*, June 3, 2010, <http://www.utilities-me.com/article-566-ksa-prepares-to-scale-back-electricity-subsidies/>.

85 Jones, *Desert Kingdom*, 235.

86 This statement is drawn from discussions with a wide range of nongovernmental and academic observers of the Syrian situation. The discussions took place by phone between July 6 and July 20, 2010.

87 Analysis on the use of treated wastewater for irrigation is derived from conversations with water experts #5, #8, and #13, March 14 and 17, 2010.

88 Conversation with water expert #1, March 14, 2010.

89 So far much of the success in collecting water bills on a local level has been achieved by the private sector. In Jordan, for example, a project by a water consultancy to improve metering and billing in Madaba encouraged residents to pay their water bills once the water meters began giving proper readings. Some residents reportedly started paying even before the company had arrived to make needed repairs. Interview with water expert #6, March 18, 2010.

90 One example of this sort of positive incentive exists in the American Southwest, where homeowners have received tax credits for installing sustainable landscape irrigation systems, and in some cases have received discounts on the purchase of the required equipment. Although water remains heavily politicized in this region and large-scale agriculture continues to overexploit water resources, incentivizing smart use on a local level has gone a long way toward lowering aggregate water demand.

91 Interviews with water experts #1 and #13, March 13–14, 2010.

92 Jones makes this point about Saudi Arabia, for example, in *Desert Kingdom*.

93 In Jordan, for example, agriculture accounts for only 3.5 percent of GDP; in Saudi Arabia it accounts for 3 percent. See “Jordan,” CIA World Factbook; “Saudi Arabia,” CIA World Factbook.

94 Ross Hagan makes this argument in reference to Jordan; see Hagan, “Strategic Reform,” 27–29.

95 Saudi Arabia has already started upon the latter course in phasing out domestic wheat production in favor of wheat grown overseas and imported back to the kingdom.

About the Authors

JON B. ALTERMAN is director and senior fellow of the Middle East Program at CSIS. Prior to joining CSIS, he served as a member of the Policy Planning Staff at the U.S. Department of State and as a special assistant to the assistant secretary of state for Near Eastern affairs. He is a member of the Chief of Naval Operations Executive Panel and served as an expert adviser to the Iraq Study Group (also known as the Baker-Hamilton Commission). In addition to his policy work, he teaches Middle Eastern studies at the Johns Hopkins School of Advanced International Studies and the George Washington University. Before entering government, he was a scholar at the U.S. Institute of Peace and at the Washington Institute for Near East Policy. From 1993 to 1997, Alterman was an award-winning teacher at Harvard University, where he received his Ph.D. in history. He also worked as a legislative aide to Senator Daniel P. Moynihan (D-NY), responsible for foreign policy and defense.

He has lectured in more than 25 countries on subjects related to the Middle East and U.S. policy toward the region. He is the author or coauthor of four books on the Middle East and the editor of two more. In addition to his academic work, he is sought out as a consultant to business and government and is a frequent commentator in print, on radio, and on television. His opinion pieces have appeared in the *Washington Post*, *Los Angeles Times*, *Wall Street Journal*, *Financial Times*, *Asharq al-Awsat*, and other major publications. He is on the Board of Advisory Editors of the *Middle East Journal*, is a member of the Editorial Advisory Board of *Arab Media and Society*, and is a former international affairs fellow at the Council on Foreign Relations, where he is now a life member. He received his A.B. from Princeton University's Woodrow Wilson School of Public and International Affairs.

MICHAEL DZIUBAN is a research assistant in the Middle East Program at CSIS. He graduated from Yale University in 2008, where he majored in political science. Prior to joining CSIS in July 2009, Michael spent a year studying Arabic at the American University in Cairo, Egypt, on a full fellowship from the Center for Arabic Study Abroad.



1800 K Street, NW | Washington, DC 20006

Tel: (202) 887-0200 | Fax: (202) 775-3199

E-mail: books@csis.org | Web: www.csis.org

