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The High Stakes of Climate Adaptation in the Middle East and North Africa

JEANNIE SOWERS

The Middle East and North Africa have a long history of adapting to drought and dealing with extremes in temperature and rainfall. Most countries in the region have extensive water infrastructures in place, ranging from dams to desalination plants to urban water utilities, which help buffer variability in rainfall and river flows. Farmers hedge climate and economic risks by tapping groundwater, diversifying household sources of income, and responding quickly to changes in price and trade incentives. Urban public cultures are somewhat adapted to intense heat; for example, many people engage in outdoor and communal activities at night. Yet these and myriad other adaptations seem increasingly inadequate in the face of accelerating impacts from man-made climate change.

Changing with the Climate

Third in a series

The protracted, severe droughts of the past decade have caught the attention of policy makers, citizens, and climate experts alike. A few years ago, several colleagues and I organized a workshop at Harvard University on climate change adaptation and water resources in the Middle East. The workshop brought together hydrologists and water policy experts from Turkey, Egypt, Saudi Arabia, Morocco, Jordan, Lebanon, and the Gaza Strip. While much of the discussion was technical, many participants—mostly older men who had worked in academia or government service for decades—shared personal observations of changing Middle Eastern climates. Summer comes earlier and lasts longer. Very hot days are even hotter, with more frequent heat waves. Concrete and brick apartment buildings in dense, expanding cities absorb

heat, threatening human health in a region where many people lack access to air conditioning.

Rainfall patterns are changing, with less rain in most months, lowering river flows and reducing replenishment of fragile coastal aquifers. When rain does come, it is often in intense bursts, leading to flash floods, erosion, and property damage from Riyadh to Tel Aviv. Water levels in lakes and reservoirs fluctuate even more than in the past, as snow and rain in upstream watersheds become more erratic. Long droughts devastate even the toughest crops, such as olive trees, and hardy livestock, like goats and sheep. The tail ends of irrigation canals run dry, and the water gets more polluted as it becomes more concentrated.

Scientific studies bear out these personal impressions. The Levant (including Syria, Lebanon, Israel, and the Palestinian territories, as well as parts of Turkey and Iraq) and much of North Africa endured dire drought conditions from 1998 to 2012, which have now returned. A 2016 NASA study analyzing tree ring records sampled across the Mediterranean, combined with analyses of the “normal” ranges for natural variation in drought over time, concluded that the long recent drought was approximately 50 percent drier than previous droughts that occurred in the past 500 years, and 10-12 percent drier than the worst drought of the past 900 years.

Unlike climate disasters such as floods and hurricanes—dramatic events that often mobilize assistance and media coverage—droughts are initially harder to detect and often unfold over longer time spans. That does not make them less destructive. In 2007, Moroccan farmers lost 74 percent of their wheat crop compared with yields the year before. Moroccans did not go hungry because the country had sufficient foreign currency reserves to import wheat. Egypt, with the largest population

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in the Arab world, is also the world's largest wheat importer. None of the Middle Eastern states are self-sufficient in cereals, nor can they expect to be. Food security is of great political and economic importance to citizens and rulers alike.

Drought also disrupts water and energy systems, which can have longer-term negative impacts on health and welfare. Decreased flows to urban water systems can lead to shortages and more contaminated water. This in turn can increase transmission of diarrheal water-borne diseases, which particularly affect the long-term health and wellbeing of children. The tight coupling of water and energy systems in arid regions also means that droughts can disrupt energy and electricity production. Low river flows limit hydropower production, while lack of water for cooling can shut down thermal power plants. Power outages at treatment plants result in increased water contamination.

Projected sea-level rise, coastal flooding, and temperature increases associated with man-made climate change are also of great concern for the Middle East. Population displacement, infrastructure damage, and economic costs from storms and sea-level rise will affect many of the region's coastal cities. The densely populated, low-lying areas of the Nile Delta are threatened by erosion and inundation, as climate change impacts are intensified by the sinking of the delta; silt and soil that used to replenish the land are trapped upstream behind the Aswan High Dam.

To project future conditions in the Persian Gulf states, a recent study combined high-resolution climate modeling with considerations of the heat and humidity threshold that humans can physically withstand without resorting to artificial means of cooling. The authors concluded that under a business-as-usual scenario for global greenhouse emissions, some cities in the Arabian Peninsula and the Gulf will become uninhabitable without almost continual access to air conditioning.

Many citizens in the Middle East increasingly recognize some of the risks posed by climate change. In 2015, the Arab Forum for Environment and Development conducted an online public opinion survey that elicited 31,010 responses from individuals representing a cross-section of different incomes and countries. When asked

whether climate change posed “a real threat to the country,” 88 percent of respondents said “yes.” In Oman, which was hit by the devastating Cyclone Gonu in 2007, 100 percent of respondents said climate change was a threat. More generally, the survey found that citizens perceive climate risks as part of a broader deterioration in their local environments. Respondents overwhelmingly said that their environment was “worse off” than ten years earlier. They identified a range of pressing local issues, including pollution associated with inadequate solid-waste collection and disposal; overburdened water treatment and distribution systems; air pollution from traffic, industry, and trash burning; and lack of green space.

As in most developing regions, the poorer inhabitants of the Middle East bear little responsibility for global warming and yet they have few easy options for adaptation. Many will suffer hardships not of their own making. The vast majority of Middle Eastern citizens, with the exception of ruling oligarchies and the privately wealthy, have not come close to consuming as much carbon as their counterparts in the industrialized countries. In a real sense, those industrialized societies have displaced the heavy cost of climate change onto poor and vulnerable communities, inside and outside their borders.

Increasing energy costs could foster economic diversification, which would help build resilience.

SYSTEMIC SHOCKS

Man-made climate change adds to several other important factors driving rapid structural change in the Middle East and North Africa. Climate impacts exacerbate challenges posed by growing populations, expanding cities, political upheavals, and flows of displaced people. The region was home to approximately 436 million people in 2016. Between 1950 and 2000, the population increased by about 3.7 times, slightly more than the rate of growth in Sub-Saharan Africa and more quickly than all other world regions. While population growth rates have slowed, the absolute numbers of people will continue to grow rapidly: large cohorts of women are of child-bearing age. Much of the population is young. The median age in the Arab countries is 22; 60 percent of the population is under 25.

The majority of Middle Easterners live in urban areas. Officially, the region's population is approxi-

mately 60-percent urban. But it is likely that these statistics significantly undercount urban dwellers in informal areas, let alone refugees and displaced persons.

The 2011–12 “revolutions” that spread from Tunisia to Egypt, Yemen, Libya, Syria, and Bahrain were driven in part by these demographic and urbanization trends. Protesters called for regimes to respect human dignity, end police and security abuses, adopt more inclusive politics, and distribute economic growth and opportunity more equally. The protests (which began before 2011 and continued afterward) built on environmental campaigns as well as mobilization by workers, professional associations, human rights organizations, Islamist movements, and others. Networks of activists in various cities and rural areas had experience dealing with the security services and in building broader coalitions. In environmental actions, they had already taken on centralized, unaccountable decision making by elites in capital cities, organized against facilities they considered polluting or harmful, and contested land-use decisions that threatened local identities and livelihoods.

State responses to mass popular mobilization varied considerably. The only nation to successfully make a transition to a new political system as a result of the 2011 uprisings was Tunisia. Oman, Morocco, and Jordan announced limited constitutional reforms and reshuffled cabinet ministers to preempt the escalation of protest. Generally speaking, these countries, along with Lebanon and Kuwait, historically had somewhat pluralist political systems and relatively open economies. Savvy political leaders and emboldened civic activists alike recognized the need to reduce social deprivation, address economic and regional inequalities, and allow some space for political participation. The degree to which states are tolerant of local-level initiatives and mobilization will become only more important as climate impacts intensify. Climate adaptation initiatives that include participation by vulnerable groups and marginalized or peripheral areas could be framed as part of broader state-society engagement.

In contrast to these somewhat accommodating regimes, threatened elites in Saudi Arabia, Libya, Syria, Yemen, Bahrain, and later Egypt responded to the uprisings with extreme violence.

These “bunker regimes” relied on their militaries and security services to suppress dissent at home. They exported violence through direct and indirect interventions in neighboring conflicts. They justified their brutal responses by invoking a range of exaggerated threats.

The ability of somewhat more inclusive Middle Eastern regimes to withstand the shock of the uprisings suggests just how insular and out of touch their more repressive counterparts had become. Their response to popular mobilization indicates that the authoritarian states will maintain strict limits on bottom-up participation in climate change adaptation. This will likely make adaptation efforts less effective and less appropriate to local conditions.

Some countries’ prospects for planned climate adaptation have withered away in the face of war. For Iraq, Libya, Yemen, and Syria, conflict and economic crisis have reversed prior development gains, erasing years of investment in expanding access to such necessities as water and sanitation

services. Adverse impacts from climate change will amplify the challenges for individuals and communities trying to secure basic needs and livelihoods. Yemen was already at a very low baseline for human

development even before its civil war. The Saudi-led air campaign and naval blockade against the Houthi insurgency have devastated the country, unleashing the largest epidemic of cholera in modern times.

Even in countries that avoided conflict, economic crisis brought on by protracted political turmoil has pushed more people to the edge. A recent report by the Arab Forum for Environment and Development estimated that the number of people in extreme poverty (defined as living on less than \$1.25 a day) in the Arab world increased from 12 million in 1990 to 27 million as of 2012. Using a slightly higher poverty line of \$2.75 per day yields a crushing 40 percent of Arab citizens classified as poor. Intra-regional variations are great: oil-exporting states of the Persian Gulf report little absolute poverty, whereas Egypt, Yemen, Sudan, and South Sudan have high levels.

POLITICAL CHOICES

Several emerging trends in Middle Eastern states have significant implications for enhancing adap-

Expansion of renewable energy offers opportunities to tackle both mitigation and adaptation challenges.

tive capacities through resource conservation and “green” development trajectories. Some initiatives have the potential to contribute both to mitigation—measures to reduce emissions of greenhouse gases—and to adaptation, namely measures to cope with risks from man-made climate change and build resilience. Realizing this potential will depend in large part on political choices.

Do central governments marginalize poor populations, informal sectors, and peripheral regions or prioritize them? Do state ministries monopolize investment and planning decisions? Are cities and provinces allowed to generate their own sources of revenue and investment? Do public authorities (such as utilities) work with civic organizations or other sources of ideas to experiment with cost-effective local solutions to upgrade infrastructure and housing in at-risk areas? Do public authorities allow private sector participation and ensure competition through regulation? Will efforts to adequately price natural resources and introduce renewable energy projects improve conditions for vulnerable populations, or simply generate rents for state elites and wealthy investors? These are all fundamentally political questions. As government responses to the uprisings suggest, significant policy divergence among Middle Eastern states has emerged and may be expected to continue.

Adaptation and mitigation efforts are broadly shaped by the incentives provided in international environmental negotiations and agreements. All Middle Eastern states signed the Paris Climate Agreement in April 2016 except Syria, which effectively had no central government at that time. (Syria finally signed in November 2017, leaving the United States as the lone holdout.) All the countries of the region also signed the prior international climate agreement, the Kyoto Protocol.

In joining these agreements, the poor countries of the region gained access to technical and financial resources, such as the Global Environmental Facility, the Green Climate Fund, the Adaptation Fund, and the Clean Development Mechanism. The wealthy countries—primarily the oil-exporting Gulf states—also had incentives to join climate agreements. They gained a seat at the negotiating table and improved their reputations, which was particularly important for Saudi Arabia after campaigns by international environmental organizations highlighted its intransigence in the Kyoto negotiations.

In terms of Paris Agreement commitments, Morocco stands out as a regional leader. Morocco

committed to reducing its greenhouse emissions by 17 percent by 2030. It also pledged that, given sufficient international resources, it would aim to meet 42 percent of its energy needs through renewable sources by 2020.

Formal adaptation efforts by Middle Eastern states track those specified in the Paris and Kyoto agreements, such as creating “National Adaptation Programs of Action” and proposing specific projects for international financing. In this respect, a number of Arab countries have comparative advantages in competing for international climate assistance with other developing countries. Egypt, Jordan, Tunisia, and Morocco have long worked with bilateral and multilateral donors on development projects, building up significant domestic expertise and capacity.

THE CHEAP ENERGY TRAP

Most Arab states set domestic prices for oil, gas, diesel fuel, water, and electricity far below world prices. These subsidies were intended to support local industrialization and constituted an important social welfare provision for poor populations. However, the generous fuel and water subsidies offered by almost every state in the region have long been criticized on the grounds that they are fiscally unsustainable, encourage wasteful misallocation of natural resources, and skew investment priorities toward resource-intensive activities. Population growth combined with rising energy demand has vastly increased the cost of fuel subsidies over time, putting great pressure on the budgets of poorer Middle Eastern states.

Subsidies have also had a number of adverse effects that exacerbate vulnerabilities to climate change. In agriculture, cheap energy encouraged over-pumping of ground and surface water for agriculture. Food security concerns prompted many states to provide additional financial incentives for the cultivation of wheat and other cereals and to expand irrigation systems during the 1980s and 1990s, even as water resources were increasingly overtaxed. The effects in Syria and Saudi Arabia are well known: both countries exported wheat even as droughts intensified and groundwater tables dropped dramatically, until wheat cultivation on such a scale was no longer viable. Initial attempts to curtail water use in agriculture also encountered opposition from agricultural lobbies in Israel, Jordan, Morocco, and Egypt.

In industry, cheap energy encouraged investors to focus on energy-intensive sectors, such as re-

fining, chemicals, cement, and fertilizer. Facilities were often built near port cities to take advantage of pipeline terminals and transport infrastructure. These capital-intensive enterprises generated relatively few jobs and increased local pollution levels, while revenues accrued primarily to state and public-private firms with little transfer to the affected communities.

Increasing energy costs could foster economic diversification into more labor- and education-intensive activities, which would help build resilience with new sources of income. Providing additional incentives to locate enterprise clusters away from coastal areas threatened by economic dislocation and infrastructure damage from sea-level rise, salinization, and flooding would also reduce the degree of exposure to climate impacts.

Pricing fuel and water to encourage resource conservation, while ensuring that poor populations have sufficient access, requires that subsidy reductions be accompanied by targeted social programs. Jordan cut fuel subsidies entirely in 2012 when faced with unsustainable budget outlays and tried to offset the anticipated hardship with cash transfers to the poor. Tunisia implemented a series of gradual subsidy reductions after the 2011 revolution. Morocco in 2008 unveiled a plan to phase out subsidies, and did so in annual increments until global prices prevailed in 2015. Egypt raised fuel prices in 2017, while announcing increased cash transfers to poor families.

The oil-exporting states of the Persian Gulf are also revisiting fuel subsidies. Major energy exporters face maturing if not depleted oil and gas fields. World prices for oil and gas plummeted in recent years as new extraction technologies brought oversupply and new competitors to world energy markets. These factors make economic diversification all the more urgent. Domestic energy demand also has sharply increased.

Saudi Arabia and the United Arab Emirates have begun to cut fuel subsidies; cuts are also under debate or in the planning stages in Qatar, Kuwait, and Oman. Since Gulf cities get their water from desalination plants powered by electricity or by waste heat from fuel combustion, rising fuel prices also increase the costs of municipal water, which is highly subsidized as well. Raising fuel and water prices would help conserve these scarce resources.

REASONS FOR RENEWABLES

Several Middle Eastern countries have announced large-scale renewable energy projects. As the cost of solar and wind technologies has dramatically declined, private and public investors have begun to consider them as a viable alternative to coal, oil, and gas. Middle Eastern states hope to claim a share of rapidly growing markets for renewable energy production and investment with the aims of increasing jobs, decreasing dependence on energy imports, freeing up remaining fossil fuels for export, and creating new green economic sectors.

The expansion of renewable energy offers opportunities to tackle both mitigation and adaptation challenges. Whether it helps build resilience among vulnerable communities depends in large part on how projects and related initiatives are designed and implemented.

The first utility-scale concentrated solar plant in the region was commissioned by Abu Dhabi in 2013. Additional solar plants of various types are planned or under construction in Jordan, Morocco, the UAE, Kuwait, Saudi Arabia, and Egypt. A range of international and multilateral development agencies have supported projects in the

poorer, non-oil exporting countries, eager to demonstrate the feasibility of solar technologies. Wind farms have proved cheaper to construct than solar plants. Morocco changed its legal framework to allow private companies to construct wind farms, while Egypt has built several successful wind farms along the Gulf of Suez.

Morocco offers an intriguing example of how to embed solar projects in broader development strategies that can enhance resilience to climate impacts. In 2016, the first phase of the world's largest concentrated solar plant—Noor 1, near Ouarzazate at the foothills of the Atlas Mountains on the edge of the Sahara—came online. The project relied on concessionary financing from the Climate Investment Funds, the European Investment Bank, the World Bank, and the African Development Bank, among others. The government also issued a green financing bond.

To encourage local development linkages, the government required that the project source 30 percent of the inputs locally, a proportion that will rise further in the second and third phases. The

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electricity generated will also be consumed domestically, as part of the government's attempt to reduce dependency on coal and oil imports, which presently supply 95 percent of Morocco's energy needs. This should yield local environmental benefits by avoiding air pollution from the burning of fossil fuels to generate electricity.

In the mid-1990s, Morocco was woefully behind Tunisia, Algeria, and Egypt in electrifying rural areas. Only 22 percent of rural areas had access to electricity services. By 2013, however, this figure had risen to 98.5 percent. Scholars estimated that gains in actual household connections were lower, but still impressive. While the government offered remote and dispersed communities the option of off-grid solar household kits, rural demand for reliable, cheap electricity through the national grid created sustained political pressure for the national utility to provide it.

This brought adaptation benefits. Grid extensions were accompanied by participatory rural development initiatives to increase incomes and diversify livelihoods, using electrification for irrigation, cooling, tourism, and craft workshops. Because firewood is still widely collected as fuel in rural areas, electrification can lessen pressures on vegetation and reduce rangeland degradation. Household health will also improve. If Morocco continues to invest in solar plants, alongside continued rural development and electrification efforts, it will see both mitigation and adaptation benefits.

VULNERABLE AGRICULTURE

Adaptation efforts in the Middle East often focus on the needs of the agricultural sector, since it consumes 80 to 85 percent of all water resources. Agriculture is particularly vulnerable to changes in temperature and water supply. Public policies to address climate risk have included expansions of water-supply infrastructure; investments in drip irrigation and other water-saving technologies; promoting no-till and low-till planting practices; and encouraging cultivation of higher-value and drought-tolerant crops.

However, the stakes for adaptation are quite different across the region. In the poorer countries, the agricultural sector remains a major source of employment. Roughly 30 percent of the total population in Egypt and 40 percent in Morocco are involved in agriculture. In Yemen, by far the region's poorest country, roughly 50 percent of the population is engaged in agriculture. In countries with

more diversified economies and technologically advanced agricultural sectors, the employment share drops dramatically: it is only 1.1 percent in Israel and 2 percent in Jordan. In both these countries, agricultural labor consists largely of foreign workers from outside the Middle East.

In the context of scarce water resources, adaptation in agriculture entails significant policy trade-offs. Upgrading irrigation systems and making them more efficient helps to buffer farmers and agribusinesses in the event of drought. However, it can also create what the World Bank has termed the "paradox of supply," in which demand for water increases as supply is made more reliable. Reducing water flows to agriculture through more efficient irrigation technologies may also reduce replenishment of coastal aquifers and river deltas, rendering them more susceptible to saltwater intrusion.

Projections of climate change impacts and population growth suggest it is likely that even well-crafted policies will be not able to sustain current levels of agricultural production in many countries in the region. Recurrent drought and increasing water scarcity expose the limits of even the most "efficient" agricultural sectors. Israel, for instance, has invested heavily in desalination for municipal and industrial use and employs technologically advanced agricultural practices, but still faces severe water shortages that divert water from agriculture. This is the case even setting aside disputes over water rights for the aquifers and river basins Israel shares with the Palestinians and Jordanians.

ENVIRONMENTAL PROTECTION

Conserving ecosystems in the Middle East can serve as an important and often overlooked adaptation measure. Yet most countries have no way of valuing "ecosystem services"—the benefits that functioning ecosystems provide to people and other organisms, including plants, insects, and animals. This is beginning to change, however. Several Middle Eastern countries, including Morocco, Tunisia, and Egypt, are in the early stages of exploring valuations for ecosystem services for incorporation into governmental budget and accounting systems. Others with track records in conservation and nature protection, such as Oman and Morocco, are revisiting "natural capital" as a means of improving climate resiliency. These include restoring or recreating wetlands and floodplains to hold floodwaters and help recharge aquifers; improving water quality by tak-

ing measures to safeguard watersheds in mountains; and increasing pollution-control measures for land and water resources.

“Old” conservation measures, such as preserving biodiversity, deserve renewed attention under conditions of climate stress. The International Center for Agricultural Research in the Dry Areas (ICARDA), for instance, has worked for forty years to improve dryland agriculture and livestock systems, with the goals of reducing rural poverty and conserving undervalued natural resources, including dryland soils and local cultivars of staple food crops. ICARDA’s gene banks store landraces (local varieties cultivated over time to adapt to particular agroecologies) of legumes and grains that long ago fell out of use across much of the Middle East. These seeds offer opportunities to develop new varieties of crops such as barley, wheat, chickpeas, and lentils that may prove more resistant to drought, salt, and disease than the few dominant types currently cultivated.

Rapid urbanization means that climate adaptation in cities is just as important as in rural areas, but it has received far less attention both globally and in the Middle East. State and private investment remains highly skewed toward luxury development, new planned cities, and tourism rather than restoring livability and upgrading infrastructure in existing urban areas. Middle Eastern cities could learn from attempts elsewhere to upgrade water, waste, and transport systems to cope with extreme climate events, including flash floods and storm surges. Large sections of many older Middle Eastern cities consist of dense informal residential areas closely interspersed with small shops, industrial workshops, and service industries. Plans to “upgrade” these areas should take into account projected water scarcities and temperature increases in designs for public utilities. Greater reuse of wastewater is imperative, as is ensuring adequate maintenance of public water systems. Rather than focusing primarily on relocating small polluting industries to adjacent areas, as has been done in Cairo, initiatives could also focus on switching from fossil fuels to renewable sources to improve urban air quality.

Adding more shaded, public green spaces could play an important role in providing spaces to play, cooling urban heat islands, and improving air quality. Instead of water-intensive lawns, these spaces should use locally adapted trees and plants, irrigated with reused wastewater. The Aga Khan

Trust’s investment in turning a former trash dump in the hills above medieval Islamic Cairo into a public green space, Al Azhar Park, is one of the few examples in Egypt of urban redevelopment for green space. But the required entrance fee means that this park is not open to everyone.

ON THE MOVE

Migration has long been one of the most important forms of adaptation to drought and war in the Middle East. The wars in Syria, Iraq, Libya, Somalia, Sudan, and Afghanistan have left millions displaced inside these countries and millions more seeking refuge across borders of neighboring states. Yet migration within and across borders is also essential for securing livelihoods in arid regions. Herding and nomadic groups moved seasonally, following rainfall and pasture for livestock. Many sought to escape poverty by leaving rural areas for provincial towns and major urban centers, and continue to do so. Over the past few decades, many people temporarily migrated from the poorer countries of the Middle East to work in the wealthy oil-exporting states of the region, sending wages home to help their families. Migration outside the region has created vibrant diasporas in North America and Europe.

Too often, climate change is invoked as simply another driver of migration and thus a potential security threat. Instead, policy makers should recognize different types of migration and the different needs of migrants and host communities that result. Climate-driven migration is typically from rural to urban areas within countries. Adaptation measures should prioritize helping those who flee particularly vulnerable areas, or facilitate initiatives that enable them to stay in place.

The Middle East and North Africa face daunting challenges from man-made climate change. Climate risks to vulnerable populations are increasing even as many people in the region also suffer from war, displacement, and economic crisis. Yet the region is diverse and the challenges are political as much as they are economic. In countries where popular uprisings led to regime change, as in Tunisia, or where incumbent elites accommodated popular protest, regimes may well be able to foster state-society engagement in managing climate risk. In countries where rulers turned to repression, sparking long-running civil and regional wars, they will be responsible for increased climate vulnerability along with great human suffering. ■