

ANALYSIS PAPER

SUMMARY

Saudi Arabia has abundant oil but very little naturally-occurring water. Yet by investing in desalination and domestic agriculture, the Saudi government has succeeded in providing plentiful water to the entire country, satisfying critical needs that many governments around the world struggle to fulfill. However, as water use in the kingdom continues to grow, some observers are worried that it will get harder to provide plentiful water forever. Desalination is expensive, and water used for agriculture cannot be replaced. As these trends become harder to avoid, the Saudi government will have to think creatively about how to save water while still reaping all its benefits. Ultimately, while the future presents uncertain challenges, the Saudi government's ability to adapt creative solutions and innovations will ensure its success.

Water and National Strength in Saudi Arabia

Of all the manifestations of Saudi Arabia's spectacular development over the past half century, none presents a starker set of contrasts than water. Oil has helped finance rapid urban development and generous philanthropic and humanitarian projects around the world. But it has also allowed the Saudi government to provide a resource that is anything but plentiful in the country's arid environment. "Turning oil into water," as one historian puts it,¹ has allowed the government to turn an environment of scarcity into an environment of plenty, with huge benefits for the kingdom's national security and national strength.

Saudi Arabia has about one seventy-fifth as much water per capita than the United States, but the average Saudi uses nearly half as much water as the average American.² Despite Saudi Arabia's harsh natural environment, its government has a remarkable ability to make water available to a rapidly growing population. By investing in desalination on a massive scale, the government has invested in the potential of its inhabitants to lead the country forward. By undertaking vast agricultural projects, the government has avoided the overreliance on food imports that sets weak nations apart from strong ones. In an environment that just a century ago was conducive to neither great wealth nor great development, investing in water provision has allowed Saudi Arabia's leaders to guarantee both.

But a growing number of observers are concerned that continuing on this path could create significant burdens. The water that Saudi Arabia uses for agriculture is finite and disappearing quickly. Meanwhile, demand for water and energy continues to grow faster than the kingdom's population, and faster, some worry, than the country's capacity to sustain it. There is concern that the stakes of successful water management are growing to the point that they could outweigh the benefits.

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The Saudi government is well aware of water's challenges, especially when it comes to agriculture. In the early 1990s, for example, the government cut back the wheat subsidies it had instituted several decades earlier to spur agricultural development, in large part because it recognized that the policy was encouraging farmers to waste water.³ Similarly, in 2008, the government announced a plan to phase out domestic wheat production entirely by 2016, again in recognition of the great strain that the kingdom's agricultural production had placed on its water resources. As it has harnessed the benefits of water, the Saudi government has also taken important initiative in recognizing constraints on water use and innovating to address them.

As the constraints increase, so will the need for innovation. Saudi Arabia faces a number of challenges to the way it uses water for both agriculture and human consumption, and some observers increasingly see these uses as unsustainable. Yet the Saudi government is well poised to confront this evolving reality, given its ability to implement creative solutions and adapt the kingdom's means of water provision and use.

BACKGROUND: WATER AND PROGRESS

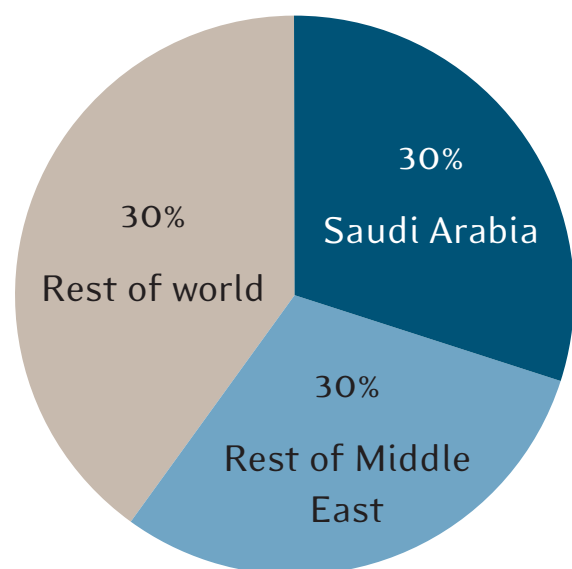
Saudi Arabia's success on water owes much to the visions of the Saudi kings throughout the country's modern history. Before American geologists found oil in the kingdom, King Abdulaziz Al Saud had charged them with looking for water.⁴ Before most of the rest of the world had even heard of desalination, King Abdulaziz had already ordered that a desalination plant be built in Jeddah to facilitate that city's growth.⁵ As time progressed, water came to feature prominently in the development strategies of King Faisal and King Fahd,⁶ as the government sought out the best avenues for distributing the benefits of oil wealth to the Saudi people. Saudi kings have long had a clear sense of water's ability to spur growth, and an equally long history of valuing technical guidance on water in addition to oil.

Sustained investment has helped turn this vision into a reality. Over the past 80 years, Saudi Arabia has spent nearly \$25 billion on building and operating desalination plants. It now has 30 desalination plants and more than

2,500 miles of pipeline to pump the water they produce around the kingdom.⁷ When it comes to agriculture, Saudi Arabia spent nearly \$84 billion on agricultural development and production over the last 15 years of the twentieth century,⁸ and between 1980 and 1990, the kingdom more than quadrupled its domestic food production.⁹ Throughout this period, the kingdom's population grew at an average annual rate of nearly 3.5 percent,¹⁰ and Saudi Arabia went from being a developing country to a modern nation within barely a quarter century. The government went from having no comprehensive water infrastructure or agricultural system to providing drinking water and food for nearly every citizen.¹¹

Such rapid development has gained the Saudi government—and especially the water sector—recognition in the international community. Since it was established in 2001, the Ministry of Water and Electricity has received four international awards for expert water management in an arid environment.¹² Saudi Arabia is now the world's largest single producer of desalinated water, accounting for about 30 percent of global capacity (fig. 1).¹³ The kingdom has used its expertise on desalination to help advance research on water production in other harsh natural environments,¹⁴

Figure 1: Global desalination capacity



Source: Banque Saudi Fransi.

and in 2002 the government established the Prince Sultan bin Abdulaziz International Prize for Water to reward innovations by other countries.¹⁵ Especially within the Gulf Cooperation Council (GCC) region, the Saudi government stands out as the government most capable of using water to spur growth and build a productive economy. The kingdom has twice the population of the rest of the GCC countries combined,¹⁶ but the government succeeds in providing about 50 percent more water per person than the average GCC country.¹⁷

By developing its capabilities and reputation in this way, the government of Saudi Arabia has also been able to shield itself from political challenges that confront less accomplished nations in the Middle East and the developing world. The country's rapid development has shown Saudis and foreign observers that the monarchy is closely attuned to its people's needs and takes an action-oriented approach toward fulfilling them.¹⁸ Elsewhere, Arabs have spent years lobbying their governments just to get the food and water they need, and in some instances the process has become violent. But rarely if ever has Saudi Arabia been the site for such struggles. The government has wisely and ably provided resources to all its citizens without them having to ask.

Yet some observers claim that the kingdom could do more to make good on its accomplishments. They fear that Saudi Arabia's groundwater could run dry if farmers are not more careful about pumping it and that desalination will get more expensive as the country's population continues to expand. Often critics claim that the government could be doing more to address these challenges. When it comes to water, they argue, greater responsibility is needed to cement the benefits of great progress.

These observers often have trouble seeing that Saudi Arabia's national development has been compressed into a very short span of time. The government may still be learning precisely how to manage the resource demands of a growing modern nation. Critics also often gloss over the fact that providing abundant water has had implications beyond domestic utility provision. Agriculture, for example, has not only fed native Saudis—it has also supplied much of the rest of the Middle East with crucial food products and created opportunities for joint ventures with international

companies.¹⁹ Using water has become more than a matter of domestic development; it has become a matter of sharing the kingdom's bounty with the rest of the Middle East. Any shift in how water is provided at home would have important implications for the region as well.

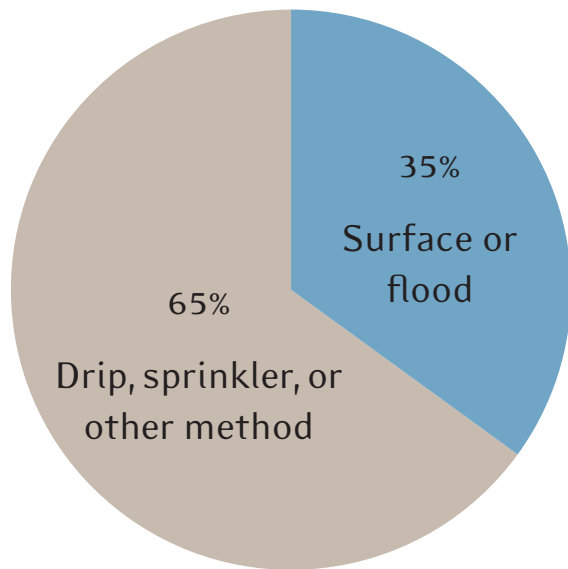
But the reality of the kingdom's harsh natural environment remains, and many believe it is growing more urgent. Observers believe the Saudi government has been successful in a number of ways in charting its future water trajectory, but they also see several lingering issues the government will have to address as it adapts to the changing reality of water scarcity.

DOMESTIC AGRICULTURE IS DECLINING BUT CONTINUES TO STRAIN GROUNDWATER RESOURCES

By 2016, the Saudi government will have stopped producing wheat domestically, giving some relief to the country's groundwater supply. Some experts believe that plans are in the works to expand the policy to include other types of domestic cultivation.²⁰ But others are worried that, until the government extends its wheat policy in this way, groundwater use may actually continue to grow. Since the announcement of the decision to phase out wheat, some Saudi farmers have switched to cultivating fodder crops that require up to 16 times more water than wheat does.²¹ While these sorts of practices help Saudi Arabia maintain its prominence in agribusiness, they also complicate the goal of water conservation behind the Saudi government's policy on wheat. As it continues to shape agricultural policies aimed at water conservation, the government will need to think carefully about its priorities for addressing the range of complex water use behaviors that help sustain agriculture.

In doing so, the government has a rich set of technical options to facilitate its policy decisions. One expert believes, for example, that greenhouse agriculture is the key to tailoring food production to domestic needs without continuing to overexploit domestic water supplies.²² Even advanced irrigation technologies have significant potential: 35 percent of Saudi farmland is still irrigated using traditional methods like surface or flood irrigation (fig. 2),²³ and converting these farms to run on drip or

Figure 2: Irrigation methods in Saudi Arabia



Source: Saudi water expert #1.

sprinkler irrigation could create profound water savings. At the very least, ensuring that all water-intensive crops employ advanced irrigation technologies could ensure that less water is lost on products with a higher value. As the Saudi government considers its priorities for ensuring long-term food security, these sorts of technological innovations are well within the reach of both the government and the agricultural companies that are its partners. The changes could save water by themselves, and they could also make larger shifts in agricultural policy easier to implement and maintain in the long term.

On the economic side, other observers believe that the Saudi government must think more broadly about what agricultural paradigm is most beneficial to the kingdom. Growing crops in greenhouses and switching to advanced irrigation might be financially and technically feasible, but perhaps it would be more efficient in the long run simply to rely more on food imports. One obstacle to such a shift is the reigning perception that strong countries are able to feed themselves, and the corresponding fear for Saudi Arabia's international image if it were to rely any more on food imports than it already does. As the government weighs its policy options for agriculture, it will need to think about how to balance the benefits of its prominence in agriculture against the realities of its water situation.

OVERSEAS CULTIVATION BRINGS SHORT-TERM RELIEF BUT LONG-TERM QUESTIONS

Beyond making strides in reshaping domestic agriculture, the government of Saudi Arabia has had considerable success in overseas cultivation ventures designed to guarantee the country's food security. In countries like Sudan and Ethiopia, investing in cultivation allows the Saudi government to dull the effects of rising global food prices and provides an opportunity for poorer countries to build their foreign currency reserves. There is also hope in the kingdom that these investments will diversify into cultivation of fish and livestock and help the government develop long-term economic relationships with partner countries.²⁴ In a similar light, the investments are also opportunities for the government to share its agricultural expertise with countries for which large-scale cultivation remains a challenge.

While this policy answers some questions, it raises others. Many nations have been receptive to Saudi initiatives, but some observers believe a new and unfamiliar set of political challenges could accompany sustained investment. Broadly speaking, once agriculture has moved from the Saudi context to foreign ones, the politics of agriculture could become much more difficult to control. Many of the nations that the kingdom is approaching for agricultural partnerships have often lacked the security to feed their own populations,²⁵ and their governments could balk at continued Saudi investment if their own food supplies come into question. In observers' worst-case scenario, a volatile government playing host to Saudi agricultural ventures could decide to nationalize these holdings—straining the kingdom's supply of food and leading to a diplomatic dispute. As it works to prevent these outcomes, the government of Saudi Arabia will have to evaluate whether the money it saves through overseas cultivation is worth the uncertainty that comes with new economic relationships with countries that are much less stable.

In countries like Sudan, investing in agriculture also presents the risk of entanglement in internal political dynamics. Sudan values Saudi agricultural investment mainly because it is helping the country diversify its economy as a hedge against a newly seceded Southern Sudan taking full control of the country's oil resources.²⁶

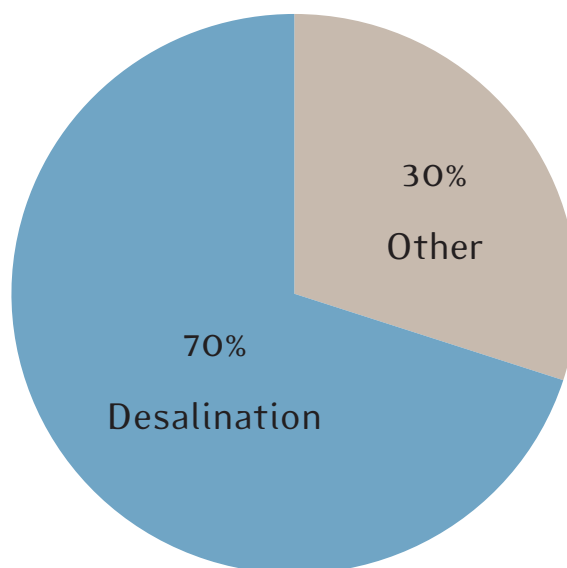
As this situation evolves, it could be hard for the Saudi government to continue partnering with Omar al Bashir's government without creating the impression of taking sides in domestic Sudanese politics. The practice of investing in agriculture abroad has already generated some controversy in the international community,²⁷ and it may only become more difficult for the Saudi government to communicate the good intentions behind its investments as the politics of foreign nations grow more complicated. The government will have to be more creative than ever in marketing its overseas initiatives, not merely executing them.

In a certain way, the kingdom has entered an ideal period in its history for thinking about questions of domestic and overseas agriculture. Saudi cultivation started as a way of building a foundation of national progress and security based on technological innovation. Today, particularly with the establishment of King Abdullah University of Science and Technology (KAUST), the government has evolved an even more sophisticated approach to science and technology. King Abdullah's vision emphasizes the importance of technological innovation to Saudi Arabia's place in the world, in addition to the country's own human capital development, economic diversification, and longevity.²⁸ This vision has created a new avenue for upholding the emphasis on progress that agriculture was originally meant to represent. The immediate challenges of food and water provision remain, but the government has already demonstrated its ability to find new ways of maintaining national strength. As water grows even scarcer, the government has a wealth of tools for ensuring the fulfillment of its vision, even as water and agriculture become much less certain.

DESALINATION IS EXPENSIVE, BUT TECHNICAL INNOVATIONS CAN IMPROVE EFFICIENCY

Beyond agriculture, Saudi Arabia faces another set of challenges related to drinking water. Desalinated water accounts for between 50 percent and 90 percent of a typical Saudi city's water use (fig. 3),²⁹ but it is not a renewable resource. The process of producing it requires a constant input of energy—something Saudi Arabia has in abundance, but something the Saudi government is

Figure 3: Sources of water in the average Saudi city



Source: Saudi water expert #1.

also increasingly conscious of using wisely. Desalination already accounts for more than half of the kingdom's domestic oil consumption,³⁰ and the demand for water and electricity co-production is growing by 8 percent every year.³¹ The good news about such high rates of desalination demand is that the Saudi population has faith in its government to continue providing water. The bad news, as some see it, is that oil will always be a precious commodity, and diverting more oil to desalination could make it harder for the government to plan its economic future. With the need for economic diversification clearer than ever, the need to use oil revenues wisely is likewise very clear. As the Saudi government works to encourage smart economic growth, it will need to think carefully about balancing the competing draws on oil resources that desalination and domestic energy production represent.

The kingdom's geographic realities present an additional challenge. Transporting desalinated water is expensive, and one of the major Saudi markets for it—Riyadh—is nearly 400 kilometers from the Gulf coast. Riyadh enjoys the sort of prosperity usually only found in coastal cities, but this means that its water challenges are also unique. As the increasing demand for desalinated water puts more of a strain on Saudi Arabia's energy resources, Riyadh is one of the first places where innovation on

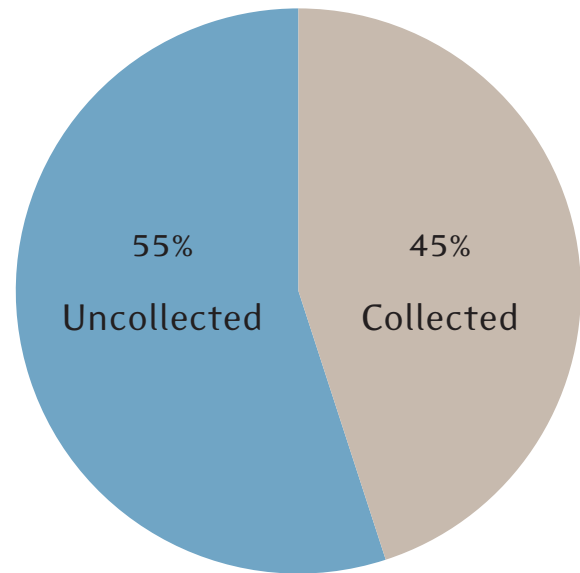
water production and management will have to occur. By the same token, whatever the government is able to learn in addressing Riyadh's water challenges will be that much easier to implement in the rest of the kingdom's cities, the largest of which are much closer to the sea.

In the face of these geographic and economic challenges, Saudi Arabia is already engaging in the kind of experimentation that can enable future adaptation. In early 2010, for example, the King Abdulaziz City of Science and Technology (KACST) launched a pilot desalination effort that uses solar power instead of petroleum.³² As the government carries out plans to invest more than \$50 billion in new and upgraded desalination plants over the next 15 years,³³ growing this sort of pilot project will be of enormous benefit to the government's efforts to save energy and maintain its finances. Moreover, it will be an opportunity for the government to maintain its reputation for technical knowledge and assistance on desalination to other nations. By innovating on its own desalination processes, the kingdom could help other arid countries adapt to the harsh environmental reality they all share.

Other technical solutions are more extensive but still within reach. For example, the Saudi government could invest in repairing water transmission infrastructure to avoid losing water through old or cracked pipes. Like many countries in the Middle East, Saudi Arabia loses nearly a third of its potable water every year to leakage in transit from desalination plants.³⁴ Fixing this problem could save the government nearly a billion dollars every year in lost water³⁵—money it could use to shield itself even further against the rising cost of water production.

As the government balances growing demand for desalination against its desire to maintain some sort of domestic agricultural footprint, diversifying the means of water production could save both water and energy. For example, the government could invest in enhanced infrastructure for collecting, treating and reusing wastewater. Using treated wastewater for agriculture could help ease the strain on groundwater resources while minimizing costly incursions into greenhouse technology or agriculture fed by desalination. Currently, only 45 percent of all wastewater produced is actually collected (fig. 4),³⁶ and an even smaller fraction is treated and reused. But compared to desalination,

Figure 4: Saudi wastewater



Source: Saudi water expert #1.

wastewater treatment has proven a much cheaper process—in Kuwait, for example, treating wastewater requires about one third the cost of desalinating water.³⁷ Using treated wastewater for agriculture would not only save the Saudi government money—it would also allow it to reserve more cost- and energy-intensive desalinated water for critical human needs.

WATER PRICING IS DIFFICULT TO CHANGE, BUT THE GOVERNMENT HAS OPTIONS FOR ADAPTING IT

Some observers see a need for change that extends beyond production and infrastructure to the way the Saudi government dispenses water and charges citizens for it. Citizens only pay about one percent of what it costs the government to provide water,³⁸ and some observers think this is unsustainable. For the government to maintain its remarkable ability to provide water amid skyrocketing demand, it may need to start recouping the costs of water production. With such a long history of providing water at such a low cost to all Saudis, the government is understandably uncertain about making this sort of change. But as demand for water and energy continues to climb, it may become harder to continue delaying a decision. Everyone in the kingdom has a

stake in ensuring that water continues to flow, and as the realities of water availability change, everyone in the kingdom will have to adapt together. Sudden changes in the country's water tariff scheme may not be feasible, but the government does need to consider more gradual shifts in the way water is provided.

As in other instances, the Saudi government's ability to invest in technology could prove beneficial. Ensuring that all cities are completely covered by water meters, for example, could help the government track water use more closely, even if it does not charge more money for water. The government has enough money to invest in advanced water metering technologies—"smart meters"—that track water use in real time and relay the data to a central processing facility. Having this sort of precise knowledge would give the government a stronger foundation for addressing the difficult questions surrounding water demand.

CONCLUSION

Saudi Arabia's unavoidably harsh natural environment suggests that the era of providing seemingly infinite water may itself have a definite end point. At the same time, the Saudi government has a range of options for innovating and adapting to this evolving reality. Ultimately these options will have to function in concert with each other. A strictly demand-side solution may not be politically feasible, but a strictly supply-side solution is unsustainable in the long run given the kingdom's growing population and lack of renewable water. The government of Saudi Arabia will have to think carefully about the most practical, efficient ways to produce, provide, and regulate water, and how these methods should be sequenced and implemented. No country can be expected to try every solution at once, but in Saudi Arabia's case, no single solution will be sufficient.

For a country whose oldest citizens are still young enough to have witnessed most of the kingdom's modern history, confronting the challenges water presents may be an unfamiliar and difficult process. But ultimately, it may be an inevitable one. Every nation reaches a turning point where it must start focusing more on consolidating progress than accumulating it. The fact that Saudi Arabia has

reached this point so rapidly is testament to its incredible growth. The way in which it navigates the transition will likewise be a demonstration of its remarkable strength.■

NOTES

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