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State of Nature: The Politics of Water in the Making of Saudi Arabia

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Power and sovereignty have long been closely tied to energy and the environment in Saudi Arabia.[1] Home to the world's largest oil reserves, the Kingdom of Saudi Arabia has been the most important supplier of the prized natural resource since at least the 1970s. Its massive deposits of crude oil have helped fuel a global energy regime that is almost wholly reliant on the power of oil for transportation and industrial production. The kingdom has benefited handsomely from its abundance of petroleum, reaping untold billions of dollars in revenue and profit in the last half century. In addition to enjoying this financial windfall, Saudi Arabia has also benefited from the political protection offered by the United States, which has made protecting the security of Saudi Arabia a high priority.[2] Although the Americans have cloaked their military engagements in the Persian Gulf in the language of freedom and the war on terrorism, protecting the flow of Saudi Arabia's oil has been their preeminent concern. Oil has also secured the political fortunes of the kingdom's ruling family, the Al Saud, at home. The accumulation over the second half of the twentieth century of petrodollars tightly controlled by the small ruling elite enabled the Saudis to shore up their political authority and to build a political system entirely beholden to them and their wishes. Oil's singular importance in the twentieth century's global economy and Saudi Arabia's privileged place within this economy have brought great wealth and political fortune for the kingdom's rulers. Indeed, it is hard to overstate the primacy of oil in Saudi Arabia's modern history.

But while oil and the wealth it has generated have been hugely important, the history of the modern Saudi state and the consolidation of the power of the Saudi royal family in the twentieth century had more complex environmental foundations. Water, agriculture, and the broader pursuit of mastery over other non-petroleum natural resources all figured in important ways in the making of modern Saudi Arabia. In the first half of the twentieth century, in fact, it was the convergence of several environmental factors—most notably the pursuit of control over both oil and water—that most shaped the contemporary political order in the kingdom. Control over both would prove necessary to secure the fortunes of the Al Saud. Until the middle of the century, the kingdom was politically fragile, vulnerable to internal rivalries within the royal family, and hampered by the state's own limited reach. In part this had to do with the vast size of the country. Forged through conquest and violence in the first three decades of the twentieth century, the foundation for Saudi authority was limited and stretched thin. Aside from the backing of a community of religious scholars based in central Arabia, the Al Saud had no significant social base of support. Over the course of the century, the kingdom's rulers would strive to overcome the obstacles to their power, most importantly by building a modern state and by mastering the environment and the large number of subjects who depended on it. Often these goals went hand in hand. By the end of the century, the Al Saud had overcome considerable challenges to its power and was firmly in control of a strong, centralized state.

Given the scarcity of life-sustaining natural resources, particularly water, on the devastatingly arid Arabian Peninsula, the Saudi ambition to control them is hardly surprising. Both settled and nomadic communities have depended on and often struggled violently for access to water resources for their survival. No less important was the role of agriculture, occupying the energies of the vast majority of nomads and settled cultivators alike, who farmed and herded intensively just to sustain a basic living. More than just asserting their authority over established farms and farmers, Saudi rulers sought to tame the environment by actively facilitating agricultural expansion across the peninsula. This strategy thereby ensured that attempts to control the environment would play a key role in Saudi plans to deepen their power over the course of the twentieth century.[3]

The emergence of a modern state in the peninsula and the role of the environment in the process both served and reflected the power of the ruling elite. The story is not only a Saudi one, however. In addition to being politically vulnerable in the first half of the twentieth century, the Saudis also lacked the technical and material resources to master the environment, oil and water included. In the 1930s and 1940s they came to rely heavily on and collaborate

with foreign experts, technical advisers, and an American oil conglomerate. The Saudis' goals were to simultaneously exploit their natural resources, engineer the environment, and strengthen centralized political authority. Their collaborators in these efforts helped to consolidate, institutionalize, and centralize Saudi political authority, as well as turn expertise and the environment itself into a source of royal power. In addition to helping establish centralized control over the environment—including natural resources such as oil and water, but also territory and people—these experts also helped build up the kingdom's administrative and governmental capacity, connecting bureaucratic power with environmental power. Their efforts brought millions of people into the state's emerging administrative order. They also assisted in securing the country's borders, created an entire new system of knowledge and information about the environment and society, directed and built the infrastructure that tied the far-flung provinces to authorities in Riyadh and Jidda, and spearheaded efforts to create a centrally controlled economy. In a place better known for the power of religion and religious scholars, it was the work of experts and their efforts to master the environment that sealed the political fortunes of the ruling elite.

While the kingdom relied heavily on foreign experts, the initiative to link the environment and the country's natural resources to power was driven by the Saudis. Saudi rulers increasingly sought and paid for information about territory, resources, and people from a variety of local and international sources. They well understood that their fortunes, like the fortunes of state builders and powerful elites everywhere, were connected to their ability to control and harness the power of nature. Environmental power was tantamount to power over people and their movements and also over commerce; ultimately environmental power was derived from and constituted the state's ability to control its own territory. And the need to control resources and space was dependent on the state's ability to catalogue and know about the environment over which it sought authority. This was especially important in the early stages of Saudi political development, when Saudi political power was tenuous and the state was only beginning to emerge. Information served the quest for control. Experts played an important role in building up knowledge about the environment and passing it along to central authorities, helping frame and shape the latter's decision making. But experts were not just compilers of data that central authorities used to know and oversee their dominion. They also influenced the very terms by which central authorities came to view the territory, resources, and people over which they sought command—shaping the terms of power and the nature of the relations through which power was enacted. Natural resources, territory, the environment more

generally, and people emerged not just as things to control but also as obstacles to be overcome, projects to be developed, and subjects to be managed. Experts maintained that these objectives could only be achieved—and both the experts' and the government's interests served—through a strong central state. The result was that managerial ability and control over the environment were collapsed with political authority. Just as important, the political nature of the relationship was obscured, masked within the language of calculated, apolitical, detached science.

The Environment and the Saudi Imperial Will

The hard work of capturing, consolidating, and developing the Arabian Peninsula's environmental resources in the mid-to-late twentieth century—when the effort to do so was the most intense—was to some extent a continuation of Saudi efforts to link the environment with power in the first two decades of the century. Indeed, their experiences in central Arabia (Najd), the austere desert homeland of the Al Saud and their base of power from the late eighteenth through the twenty-first centuries, demonstrated to the Saudis that the expansion of agricultural production often proved a matter of life and death. The Najdi climate severely restricted the quantity and quality of agricultural production for those who lived there. Until the middle of the twentieth century, settled residents made do by tapping as much nutrition as they could from the region's limited environmental resources. Although the region was not particularly conducive to sustained agriculture, various forms of farming were nevertheless the central pillar of economic life. While Najdi farmers manipulated the limited resources available, they faced perennial hurdles in producing enough food to meet local needs. One historian has noted that "although every piece of cultivable land was used as intensively as traditional techniques allowed, Najdi towns were seldom self sufficient."[4] For the Saudis, who already constituted a ruling elite in the settled communities of Najd in the eighteenth century, environmental austerity and the limits it imposed on both economic and political power led them to look for ways to expand their reach into the more fertile and resource-rich regions of the Arabian Peninsula.

Indeed, well before they set out to use agriculture as a tool in consolidating their political power and defeating potential rivals in the twentieth century, the Al Saud sought to expand their sphere of influence in the eighteenth and nineteenth centuries by capturing rich agricultural resources beyond Najd. The eastern periphery of the peninsula was where they would find the most

alluring prizes. The two oases of the Eastern Province, al-Hasa and Qatif, were particularly attractive.[5] In contrast to the deserts that dominated Najd, the oases of eastern Arabia were resource rich, awash in life-sustaining water and copiously stocked with lush palm groves and vegetable gardens. Hundreds of thousands of palm trees packed the eastern oases. Water, which flowed from artesian wells, streamed like veritable rivers through the region's gardens. Dates were the dominant crop. But Hasawi and Qatifi farmers also cultivated an array of fruits and vegetables, including pomegranates, apricots, peaches, figs, cucumbers, tomatoes, lemons, oranges, various melons, green beans, and even cotton.[6] Over the course of two centuries, Saudi leaders routinely strove to capture and control al-Hasa's and Qatif's abundant resources.[7] The Saudis coveted the produce, the wealth it generated—both al-Hasa and Qatif were connected to global trading networks that spread from the Persian Gulf to East Africa and South Asia—and the precious water and fertile soil that made it all possible. Their remote outpost in Najd was too isolated and possessed none of the potential for income so abundant in the east.

The Environmental Foundations of the Modern Saudi State

The same calculus was at work in the twentieth century, when in 1913 the Saudis would finally conquer the Eastern Province and set out to build a modern state. The fledgling Saudi state desperately needed considerable resources to survive. Through the first five decades of the century, it had access to limited revenue. In 1933, Riyadh entered an agreement with a consortium of American oil companies that would become the Arabian American Oil Company (Aramco) and began to rely heavily on them for loans drawn on future oil revenues. But oil production and the income that the sale of petroleum would deliver was limited until after World War II. Until the end of the war the main source of income for the central government was the tax revenues generated by the annual pilgrimage to Mecca (*Hajj*) by foreign visitors. Pilgrimage revenues were, however, unreliable in the long term. During times of global crisis, such as during the Great Depression or during World War II itself, when pilgrims faced financial or logistical obstacles to travel, the *Hajj* failed to bring in enough tax revenue to support the Saudi government or its ambitious schemes to establish hegemony across the very large Arabian Peninsula, which is roughly one-third the size of the United States. Control over the environment and agriculture and the search for new natural wealth was partly intended to help expand the Saudi purse, either through direct control or through the taxation of others. While tax revenue on farming would

always remain limited, the Saudi state was hardly exceptional in its drive to drum up as much cash as possible. Eventually, oil would obviate the need for a systematic tax infrastructure. Beyond the issue of taxation, the Saudis also sought to integrate the peninsula's agricultural hinterlands into a centrally controlled economy. They did not fully succeed until midcentury, when efforts to co-opt merchants and farmers began to yield results, but the understanding that economic integration would strengthen Saudi power was accepted as necessary during the first few decades of the century.[8]

The most important aspect of the effort to control the environment and establish authority over the region's natural resources was political. Because most of the kingdom's subjects were engaged in some form of agriculture—thus engaged with or dependent on the environment—it made sense to target agriculture and the environment as objects of state power and control. Periodic surveys and studies revealed a consistent pattern over the course of the twentieth century. The United Nations Food and Agricultural Organization (FAO) documented in 1956 that 78 percent of the kingdom's citizens made their living from agriculture.[9] According to the FAO, only 22 percent of the national population was urban. Even as late as 1970, as much as half the population worked either as agricultural day laborers or on their own farms.[10] The Saudi Ministry of Agriculture reported in 1974 that out of a population of about seven million, around 45 percent of the entire labor force was in agriculture.[11] While much Saudi energy was spent on integrating farming communities into the kingdom's sphere of influence, most pastoralists were not permanently settled. No figures are available for the percentage of the population constituted by nomadic and semi-nomadic communities at the beginning of the century. But the FAO report claimed that at least 66 percent of the population continued to be nomadic as late as 1956. Although settled farming communities were not always easily pacified, the Al Saud and their supporters eventually quelled most into submission.

Rulers used water and agriculture as tools to subdue potential threats to their authority. Potential rivals included the settled farming and merchant communities that lived along the Arabian Peninsula's shores, including al-Hasa and the Hijaz in the west. These communities had much to lose financially and politically with the ascendance of the Saudis. And they would indeed eventually lose, although the Al Saud used a combination of incentives and penalties to compel the cooperation of the merchants. Most importantly, the Saudis and their backers used agriculture to rein in the tribal and Bedouin forces that threatened their newfound and still loose grip on power. The Saudi Arabian historian Abdulaziz al-Fahad has observed that "in writings about the country, the Saudi state is typically identified with the Bedouin, the tribe or nomads, and

'tribal values' are supposed to suffuse the state, at least at its inception. Such identification is difficult to sustain notwithstanding its prevalence, for this state had been (and continues to some extent to be) an exclusively *hadari* [settled] endeavor with profound anti-tribal and anti-Bedouin tendencies, and circumscribed roles for the Bedouins and their tribes."[12] Establishing the kingdom and successfully securing it depended on overcoming tribal tensions and defusing the threat posed by communities who had long enjoyed freedom of movement. Indeed, if the raiding (*ghazu*) that generated part of tribal income was allowed to continue, it would have represented a real threat to the integrity of the Saudi polity and the ability of the country's rulers to assert their power.

Almost immediately after grabbing control over Riyadh in 1902, the Saudis launched a two-pronged strategy to bring the Bedouin under control. The first tactic was to expose them to an intensive proselytizing and recruiting campaign, inculcating them with the Wahhabi spirit, thereby exploiting faith to build loyalty.[13] The second strategy was to settle them in permanent agricultural cooperative farms, a project that aimed to transform them into a *hadari* (settled) and, ultimately, warrior class answerable to centralized power in Najd.[14] The program proved very successful initially, and the newly settled Bedouin came to be known as the *ikhwan* (brothers). Their most important role was that they formed a mobile and rapid strike military force, one that proved instrumental in helping the Al Saud conquer the Arabian Peninsula.[15] Adept at war, the *ikhwan* proved less adept at farming, taking slowly if at all to agriculture.

Although the *ikhwan* did not take the agricultural imperative seriously, the strategic importance that the Saudis gave to the settlement project indicated a major turning point in the political history of the Arabian Peninsula. Promoting sedentarization and using settlements as instruments to overcome politically threatening raiding practices reflected a new strategic thinking on the part of Saudi leaders. With the aid of supportive religious scholars, who saw their own influence grow with the emerging power of the Al Saud, Saudi rulers partially justified their rule through the exploitation of the environment and through socio-environmental engineering.

The Al Saud learned to see water as strategically critical, especially when they sent their newly created warrior class the *ikhwan* on military missions. It made little sense to have settlements clustered tightly around the seat of power in Najd, although that would have made administrating and governing the communities considerably easier. Knowing about and establishing control over water wells spread across the peninsula made it possible to maintain military outposts at strategically vital locations, some closer to the Hijaz and others nearer al-Hasa.

Oil, Expertise, and Environmental Authority

With the discovery of oil in the late 1930s, a new era of environmental power emerged in Saudi Arabia. Before the discovery of oil and the "petrolization" of the Saudi state, however, the kingdom's leaders turned to the science of geology—and to American geologists in particular—in the hope of unearthing something of value from the arid landscape. In fact, the discovery of oil was the result of the government fully embracing environmental science and applying it in the consolidation of centralized authority. And the discovery of oil should furthermore be seen as a product of the continuation of the strategic thinking that first evolved while attempting to settle the Bedouin. Saudi leaders came to see that knowing their natural environment more systematically was a precursor to controlling the political one. The discovery of oil was the most important result of this determination, but it was not the only one. Oil would eventually strengthen Saudi power in ways previously unimaginable to the kingdom's rulers. So too would the work of American and other foreign experts who helped the kingdom locate and extract petroleum from the ground. But before the work of searching for and selling oil proceeded, the Saudis turned to Americans to help them find water.

The impact of the work carried out by American experts in support of the Al Saud was felt beyond Riyadh. Indeed, Saudi–American relations were first shaped in the 1930s by the work of American geologists, most of whom simultaneously served American and Saudi Arabian political and commercial interests. Since World War II, when the potential of the kingdom's bountiful oil reserves became well known, the U.S. government has prioritized the security and stability of the Saudi regime, no matter how dreadfully it has treated its own citizens. A stable tyrannical Saudi government beholden to American oil companies and to U.S. security assurances was far more preferable to a politically open state that would potentially prioritize its own citizens' needs and interests over that of American consumers or global energy markets. For American business—big oil as well as smaller independent consultants, scientists, and engineers who went to work for the Saudi government—helping safeguard the stability of the Saudi regime also meant ensuring access to some of the windfall generated by the sale of oil. The pursuit of profit and wealth went hand in hand with efforts to strengthen the capacity and reach of the central Saudi government.

Saudi leaders were attracted to the work of geologists and environmental experts in part because they held the scientific keys to expanding the state's knowledge of its natural resources. There were Saudis and other Arabs in the

peninsula who would help in exploring and mapping the countryside, but the Saudis harbored concerns about relying on potential domestic rivals for collecting information. And while there were locals who would carry out the work on behalf of the authorities in Riyadh, their numbers were limited. In addition, the Americans offered something beyond political expediency and basic scientific ability. Equally important was the establishment of the connection between science, environmental expertise, and authority. Expertise itself became a measure of authority and this was something that state leaders would subsequently aspire to make a central part of their own ruling strategy.

The Saudi patriarch 'Abd al-'Aziz ibn Saud invited the first American geologist to survey his territory's natural resources several years before he became king. In 1930 he invited Charles R. Crane—a former U.S. representative to China, a philanthropist, and someone who became deeply involved in the political changes that swept the Middle East after World War I—to visit Arabia. The Saudi leader requested Crane's assistance in carrying out an inventory of the peninsula's water resources. Several years earlier Crane had undertaken a similar survey of Yemen. In Yemen, Crane turned to the American Karl Twitchell as his chief geologist and engineer, sending him on several tours to carry out the surveys as well as to complete other infrastructure projects. Twitchell looked into the possibility of building a Yemeni road network, establishing agricultural demonstration farms, installing water pumping windmills and irrigation networks, and erecting "the only steel truss highway bridge in Arabia."[16] According to the American geologist and engineer, who later recorded his experiences in a volume published in 1947, "reports of these unusual gifts reached Saudi Arabia," and "Mr. Crane accepted an invitation of King Ibn-Saud to visit him in Jidda" in order to explore potential ways the Americans might aid the Saudis.[17] "It soon appeared" to Twitchell that the Saudi king's "principal desire was to find ample water supplies, especially flowing artesian wells in the Hijaz and Najd."[18] Crane subsequently agreed to send Twitchell to Arabia to help the Saudis. Twitchell began a comprehensive survey, spanning 1,500 miles, of the Hijaz's water resources in April 1931. The survey returned disappointing results. Twitchell found "no geological evidence to justify the hope for flowing artesian wells."[19]

The Saudis remained undaunted. The absence of much-hoped-for natural riches in the Hijaz did not dampen their belief that the peninsula was home to mineral and natural wealth. Nor did the scarcity of water resources in the Hijaz undermine the Saudi belief that water was the key to political power elsewhere in the region. After his 1931 visit, Twitchell was subsequently contracted by 'Abd al-'Aziz to "advise him on the water resources and oil possibilities in his province of Hasa along the Persian Gulf. Although this would be a thousand

mile trip over rough country, where no American had ever been, the invitation was readily accepted."[20] It was in al-Hasa that Twitchell and his fellow geologists would make their most significant discoveries. Twitchell spent several weeks studying al-Hasa's environment and geological features. He even sailed to Bahrain, a small island located a few miles off the eastern shore of the peninsula. Bahrain possessed similar characteristics to al-Hasa and exploratory drilling for oil was already under way on the small island. Twitchell believed that there were significant deposits of oil in Bahrain and on the peninsula. Even so, he advised caution. After returning to Jidda, Twitchell encouraged the Saudis to wait for the results of the Bahraini test drills before proceeding with any petroleum exploration plans in the east. The king heeded Twitchell's advice. Twitchell later recounted that 'Abd al-'Aziz made clear "that on account of the depression, with the lack of pilgrims and consequent fall in revenue, he could not afford to follow out the development previously planned and agreed upon. Furthermore he wished me to try to find capital to carry out the development previously discussed [more mining, surveys for water resources, and test drills for oil]."[21]

Twitchell returned to the United States in early 1932 to try to drum up support for oil exploratory work in Arabia. Motivated by the conviction that oil was there awaiting discovery, the geologist, once carrying out the work of a philanthropist, now saw an opportunity for personal gain. In July he began exploring for oil in the Arabian Peninsula. In spite of initial rejections by several mining and oil companies, Twitchell persisted and his efforts eventually led to the signing of Saudi Arabia's oil concession agreement with the Standard Oil Company of California (Socal) in May 1933, which formed an operating company that ultimately came to be known as the Arabian American Oil Company (or Aramco).[22] The Saudi Arabian government granted Socal the exclusive right to explore for and extract oil in al-Hasa (over an area of 318,000 square miles) in exchange for royalties if any was discovered in commercial quantities. Socal also secured a loan of £33,000 in gold sovereigns to be given to the kingdom in advance. Late in 1933, the first wave of oil company geologists landed and initiated their search for oil in al-Hasa. After five years of frustrating results, they struck commercially profitable oil at Jabal Dhahran in 1938. Within decades, Aramco would discover the largest oil field in the world at Ghawar, just west of the al-Hasa oasis, securing Saudi Arabia's place as the largest and most important oil producer on the planet.

The presence of oil in al-Hasa and its subsequent development proved to be the most important geological discovery in the kingdom's brief history. The wealth it eventually generated did more to shore up Saudi political authority than agriculture could have accomplished even in the best-case scenario. Saudi rulers appreciated this fact early on. Even so, it did not diminish their efforts

to learn more about the still much-needed water and to pursue the intensification of agriculture. There was perhaps a simple reason for this. Oil generated income, but wealth alone was not sufficient to build power. It did not confer credibility and it did little to bring subjects directly into the orbit of the government. For these things to happen, oil wealth had to be spent. And it was through non-petroleum environmental projects that it would often be put to use. Most of the young kingdom's subjects continued to be engaged in agriculture and were hence dependent on water for their livelihoods. Even though the state did not look at its citizens as a source of revenue to be gained through taxes or other means, it continued to believe that the population needed to be productively engaged and that managing resources was a key to state oversight, administrative power, and security. Particular emphasis was placed on building an integrated administrative and economic network controlled or at least monitored by the central government. Moreover, aside from filling the Saudi purse with much-needed revenue, the discovery of oil also helped heighten both Saudi faith in science and their belief that it would be geologists who would help the kingdom locate and harness whatever resources remained undiscovered.

In 1940, King 'Abd al-'Aziz and Abdallah Sulaiman once again asked Karl Twitchell, who was visiting Riyadh, if he might be able to assist in locating natural resources in Najd and to introduce water drills, pumps, and other farming technology to the region. Twitchell was about to return to the United States to begin another search for partners who would be willing to sign on to carry out the work of surveying the Najdi environment. But before he left for the United States, the finance minister charged him with another task. Sulaiman asked Twitchell to travel south and undertake a study of the kingdom's southwestern province of Asir. Asir, home to rugged mountains, was difficult country to access. Because the Saudis hoped to ease their ability to access their southern reach, they sent Twitchell, along with Saudi mining engineer Ahmad Fakhry, to do the exhaustive work of surveying the landscape and making suggestions about how it might best be utilized. The two engineers, along with teams of local guides and assistants—whom Twitchell barely acknowledges in his account—were charged with several objectives. Sulaiman asked them to map the terrain, to measure and mark the steep mountain grades for a road network, to make initial determinations about the prospects for future mineral mining, and to catalogue the area's potential water resources and agricultural prospects. Twitchell, Fakhry, and their team spent several months making their way through Asir's passes. Twitchell corresponded regularly and directly with the king, providing detailed updates on his findings.

The team's work in Asir was particularly important to Saudi Arabia's rulers, both because of its potential environmental power and for strategic

reasons. In fact, the two went hand in hand. Riyadh's grip on the region was still tenuous at best. The Saudis took control of the province in the mid-1920s. In 1934, they were forced to defend the possession from a rival claim leveled by forces in Yemen, on Asir's southern border. Because the Saudis valued Asir for its fertile soils and the potential it held for future mineral mining, they sent in Twitchell and Fakhry to carry out the preliminary work of fortifying the central government's presence. Not only did Twitchell and Fakhry investigate and inventory resources, but they also initiated the process of road building. The early roadwork carried out by the Twitchell-Fakhry team made passage as well as the extraction of resources and revenue much easier. More importantly, the new roads would also make it far easier for the central government to police and secure a vulnerable region.

Water and the Agricultural Imperative

Two years after completing his work in Asir, Twitchell returned as part of a group sponsored by the U.S. Department of Agriculture to carry out even more extensive surveys of the kingdom's natural resources. As was the case in Asir, the Americans were guided and influenced by local inhabitants who possessed their own knowledge and expertise of the region. The published report produced by the mission offered little insight into their role or their impact on the survey team's findings or experience. With the direct support of the U.S. government, the survey's mission was considerably expanded to cover much more of Saudi Arabia than just Najd. From May 15 to December 5, 1942, the team traveled eleven thousand miles by car, camel, and foot exploring and cataloguing the geological and agricultural possibilities in the kingdom.[23] The team's field research, while extensive, was still only a preliminary estimate of the water and agricultural potential of the kingdom. Other experts in subsequent years would carry out more exhaustive surveys that would yield greater insight and detail. Although it provided only a partial look, the survey itself, as well as its particular details and the suggestions it made, offered the first methodical portrayal of the region. It came to serve as a foundation for future efforts to engineer the environment and for more effective centralized oversight over the kingdom's vast territory and the people who lived there. Twitchell and his colleagues saw themselves as a force for progress, but their work also served specific political goals, especially the strengthening of the royal family and the polity.[24]

The U.S. agricultural mission's report was an inventory of water, land, and agricultural resources. In spite of the limitations imposed upon the survey team by the demands of time, poor transport, and the elements, the report is

authoritative. The mission surveyed many of the communities and locations on the peninsula already actively engaged in settled farming, including al-Hasa, Najd, the Hijaz, and Asir in the southwestern corner of the kingdom. They inventoried a number of environmental metrics, including average annual rainfall, varieties of soil, quality of soil fertility, water resources, and kinds of crops being grown. They also offered some limited commentary on farming methods, especially at an experimental farm that had been set up in al-Kharj southeast of Riyadh.

Their primary objective was to outline where and how intensive efforts might expand the areas being cultivated. But the mission also helped establish the foundation for a new kind of political language and knowledge, one in which science overlapped with and reinforced geostrategic interests. In doing so, the U.S. agricultural mission contributed to the ongoing development of the Saudi strategic thinking that had emerged earlier in the century.

Twitchell argued that the kingdom's four regions—the territories conquered by the Saudis only a decade before that had historically maintained cultural, social, and political autonomy (al-Hasa, the Hijaz, Najd, Asir)—also served as a convenient classification system for describing the kingdom's environmental characteristics and water resources. Al-Hasa in the east was historically the most fertile area in the Arabian Peninsula and home to its richest underground water resources. Likewise, there are real topographical and geological features that distinguish the western provinces (the Hijaz and Asir) from the center (Najd) and the east, although they blend together at some point, making the actual distinctions between them somewhat arbitrary. But while the mission's classification system possessed geological and geographical plausibility, it also had political implications. The use of geology to justify the existing geopolitical classification reinforced to the Saudis that these areas were objects to be captured and exploited. This was further emphasized by the decision of the report's authors not to discuss people. Instead, they emphasized geology and water over actual human communities. The Americans created a powerful new knowledge system for the central government that prioritized descriptions and classifications of nature over descriptions of social and cultural life. This would continue to be a feature of state-sponsored agricultural work throughout the twentieth century.

Just as important as the knowledge system were the details it revealed about the location of the water resources being surveyed. Previously, various communities, including the Saudi family itself, had to compete for resources. The outcome of this competition was largely determined by knowledge of where things were and the ability to police them. The U.S. agricultural mission eliminated the need for Riyadh to bother with the process of "discovery."

The mission pinpointed with precision the location of some of the most important resources and provided valuable details about water depth, sustainability, and usability—all vital to a central government that considered control over such resources as important to its power. In addition, the report emphasized the very strategic logic that the Saudis had already begun developing themselves: because the center was natural-resource poor—the Najd was clearly the least fertile region and had the least water resources—capturing resources from the periphery was a key to power.

Thus, the U.S. agricultural mission sought to accomplish much more than simply help the central government capture resources from its provinces. In their final report the team provided a scientific framework, including a set of recommendations, that would help the central government more fully include far-flung areas within its sphere. It accomplished this by arguing that existing production levels of local agricultural areas were disappointing and by offering specific suggestions on how those levels could be expanded. The mission's aim was not to serve local cultivators, but rather the government that sought to increase revenue and establish its own presence. The Americans exhorted the Saudis to take on "reclamation" projects that would expand output throughout the kingdom. And their focus was on water—improving access to it, managing its use, and implementing extensive irrigation and pumping systems. The report pointed out that "it is [probable] that an inadequate water supply in all of its aspects, including quality, has caused the greatest damage" to agricultural production.[25] But even in spite of Arabia's scarce water resources, the report's authors were confident that better water management would yield much-improved returns. Improved irrigation would "conserve the precious gift of Allah—water—and will result in the springs and wells flowing for many years instead of flowing less and less each year until some day in the future they will stop flowing."[26]

Scientific management, the mission's report declared, offered the keys to accomplishing this. The report called for the introduction of drainage and irrigation networks all across the kingdom, in addition to ongoing efforts to find additional resources by continual test-drilling. The successful operation of an extensive national network of irrigation systems also required constant observation and data collection. Maintaining regular hydrological and climatic data served scientific ends, but it also offered an opportunity for central authorities to assert themselves and their interest over the environment more broadly. The report's authors even suggested combining data collection with the work of territorial occupation: "the work of collecting and recording these data could be assigned to the commandants of the various army posts throughout the country."[27] Of course, they envisioned these efforts to be in the service and under the

control of the central government. The mission did not imagine that Riyadh could or would carry out all of the development work on its own. But the central authorities would have a guiding, managerial role to play, one in which they shaped practice, determined priorities, and pushed the populace toward outcomes useful to the state. Because the overwhelming majority of the country's subjects were engaged in some form of agriculture, the pursuit of expanded productivity would be best served by improving the farmers themselves, refining their methods of cultivation, and linking farmers in both material and less tangible ways to the state.

The Americans assumed that the kingdom's territory was unified, that it represented a single national space but simply lacked the infrastructure and systems to make it more efficient. The truth was that the kingdom was beset with internal rivalries and differences. In the 1940s, Saudi authority was feared by most of those who resided within the state's boundaries, but it was hardly accepted. It is unlikely that many cultivators from across the peninsula would have agreed with the U.S agricultural mission's objectives of expanding fertile areas in the interest of a national economy, although they may have appreciated the additional revenue generated by new fields. But this was not what the agricultural mission had in mind. Twitchell's team did not advocate greater privatization for local farmers nor the creation of "free markets." Instead, they called for more oversight and presence on the part of the central government, and they provided a detailed balance sheet about local resources to guide the government on where to concentrate its efforts. On the surface, the argument for greater centralized control over markets contradicted the capitalist free-trade model of development that was emerging in early twentieth-century American foreign policy and that would become a staple of the postwar period.[28] It is plausible that Twitchell and his colleagues did not consider the kingdom ready for the creation of open markets and that they believed the state was needed to lay the groundwork for a more mature national economy, though they did not remark openly on this.

In reality, the argument put forward by Twitchell served American interests—both government and business—particularly well, and the American preference for centralized Saudi control over its domestic market would indeed prove a cornerstone of U.S. foreign policy. The argument in favor of helping establish a strong government was tied directly to the American desire for political stability in Saudi Arabia. Even in the early 1940s, before the terms of American–Saudi relations had become totally clear, the United States understood that because of its rich oil deposits the kingdom would be a critical postwar partner and a key ally in the battle to control both the postwar global economy and the flow of energy resources.[29]

There was another powerful incentive for the Americans to help expand the kingdom's economy, encourage the development of its environment, and promote strong Saudi oversight. Often described as a philanthropist or as a scientist devoted to the principles of progress and to helping develop one of the United States' most important allies, Twitchell also sought to benefit materially from his ties to the kingdom and its growing oil revenues. When seen as someone on the payroll of the state, an entrepreneur in the pursuit of a small share of the oil bonanza, Twitchell's arguments for and influence on the creation of centralized Saudi power over a national economy undermine the claim that he was an objective expert. Instead, he was someone whose material interests almost certainly shaped the kind of expertise he provided. In the decade following the U.S. agricultural mission to the kingdom, Twitchell continued to serve the Saudi government as the vice president of the American Eastern Consortium (AEC), a business that provided expertise on mining and mineral extraction, and as a personal consultant to Abdullah Sulaiman. Even after completing the work of exploration, Twitchell turned to the work of extracting resources and taking on a more direct role in shaping the country's development planning capacity. He was committed to various mining activities in Najd and the Hijaz, and he devoted his personal energy to the mining of various minerals while working for the AEC. He also maintained an active presence in consulting for the government on agricultural, hydrological, and other geological matters.

In May 1949 at the request of Abdullah Sulaiman, Twitchell spent a great deal of time with the new minister of agriculture assessing the kingdom's agricultural strategy and offering his own insight on future efforts. He followed up the meeting with a personal letter to Sulaiman in which he outlined a long list of things the government should prioritize, from road building to dam building to the use of fertilizer and the creation of demonstration farms. A month later, again at the request of the finance minister, Twitchell even drew up a detailed three-year plan for development, a systematic blueprint advising the Saudis on how to best focus their energies on various matters, including agriculture, mining, transportation, education, communication, health care, and even Saudi Arabia's prisons. Twitchell wrote assertively on which regions needed most attention.[30]

Twitchell's expanded influence was based on his years of experience and his privileged access to Saudi power brokers. His access continued well after his extensive travels and surveys. Throughout the 1940s and well into the 1950s, Twitchell actively corresponded with Abdullah Sulaiman about mining, the environment, and agriculture, offering insight as to what he believed the country needed. He also used his access to cash in, serving as a

purchasing agent, establishing relationships between the Saudi government and American suppliers, and ensuring that the Saudi and American markets were firmly interconnected. Mining work continued into the 1950s, although it is unclear how successful any of these efforts turned out to be. Beginning in the late 1940s Twitchell spent less time in the kingdom, offering advice mostly from afar. The Saudis never discovered large veins of gold nor did they turn up any mineral sources of revenue that rivaled oil. Failure of the mining operations to yield anything of value never diminished Twitchell's efforts to explore, and profit, further. The Saudis also remained committed to the search for new resources.

The Politics of Development and the Redistributive State

Karl Twitchell's failure to discover extensive new resource deposits did not alter the kingdom's environmental political imperative. Throughout the 1950s, 1960s, and 1970s, the state would continue to work to find new resources and to expand its control over the environment. And with rapidly expanding oil revenues from the 1950s on, the government became even more ambitious. In the middle decades of the century, the state began to spend billions of dollars on massive environmental development projects. These included dams, sprawling irrigation networks, agricultural research farms, and—perhaps most spectacular of all—dozens of expensive plants for the desalination of seawater. By the end of the 1970s, the Saudis were spending as much on desalination as they were on education; each plant cost hundreds of millions of dollars to build and operate.

By then the political logic that informed the kingdom's approach to the environment had undergone an important transformation. In the kingdom's early years, when the state was politically weak and vulnerable, establishing control over the environment was part of a program to build up the state's political and institutional capacity. By the 1950s and 1960s this had largely succeeded. The state remained susceptible to pressure, but it was in a considerably stronger position. Not all of the kingdom's subjects accepted the legitimacy of the ruling family, but the Al Saud were nevertheless firmly in control and in charge of an increasingly powerful centralized state. The Ministry of Agriculture and Water, an extensive agricultural loan program, and various development projects brought millions of Saudis directly into the material and administrative orbit of the state. By the late 1970s, the Saudis—now flush with billions of dollars in revenue as a result of the oil boom—were no longer pressed to build political capacity. Instead, the state was confronted with the challenge of

redistributing some of its massive wealth. Subsidizing water, agriculture, and making the environment and the country's limited natural resources easier for citizens to access emerged as important parts of Saudi Arabia's post-boom redistributive political order, a system that used patronage more than coercion to ensure Saudi authority.

In the first half of the twentieth century, however, the Saudis could hardly have imagined the scope of the wealth they would eventually possess or the challenges of having too much money. Simply consolidating power was challenge enough. The Saudis though did have powerful patrons—including American oil interests, the American government, and American scientists and experts—who anticipated Arabia's environmental potential. Their efforts to explore for and extract water and oil helped the Saudis achieve their domestic political ambitions. Their efforts also helped secure the kingdom's place in the global economy and its centrality to the global energy regime dominated by oil.

Notes

1. This chapter is adapted from Toby Craig Jones, *Desert Kingdom: How Oil and Water Forged Modern Saudi Arabia*, (Cambridge, MA: Harvard University Press, 2010).

2. For more on the role of security in American foreign policy in the Persian Gulf, see F. Gregory Gause, III, *The International Relations of the Persian Gulf* (New York: Cambridge University Press, 2010).

3. In this way Saudi Arabia's modern political history was hardly exceptional. For more on the connections between state authority, space, technology, science, and the environment, see James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998); Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002).

4. Guido Steinberg, "Ecology, Knowledge, and Trade in Central Arabia (*Najd*) during the Nineteenth and Early Twentieth Centuries," in *Counter-Narratives: History, Contemporary Society, and Politics in Saudi Arabia and Yemen*, ed. Madawi al-Rasheed and Robert Vitalis (New York: Palgrave Macmillan, 2004), 82.

5. Hamza al-Hassan, *al-Shi'a fi al-Mamlaka al-'Arabiyya al-Sa'udiyya*, vol. 2 (Mu'assasat al-Baqi li-Ihya' al-Turath, 1993), 293–294.

6. Muhammad Said al-Muslim, *Sahil al-Dhahab al-Aswad*, 2nd edn. (Beirut: Dar Maktabat al-Hayat, 1962), 205–206.

7. Alexei Vassiliev, *The History of Saudi Arabia* (London: Saqi Books, 1998), 225.

8. Kiren Aziz Chaudhry, *The Price of Wealth: Economies and Institutions in the Middle East* (Ithaca, NY: Cornell University Press, 1997); Daryl Champion, *The Paradoxical Kingdom: Saudi Arabia and the Momentum of Reform* (New York: Columbia University Press, 2003).

9. FAO, cited in Karl S. Twitchell, *Saudi Arabia: With an Account of the Development of its Natural Resources*, 3rd edn. (New York: Greenwood Press, 1969), 21.

10. Vassiliev, *History of Saudi Arabia*, 412–419; J. S. Birks and C. A. Sinclair, "The Domestic Political Economy of Development in Saudi Arabia," in *State, Society and Economy in Saudi Arabia*, ed. Timothy Niblock (New York: St. Martin's Press, 1982), 199–200. Vassiliev estimated the population in the 1960s to be between 3.5 and 4.5 million people. However, there was no census data and all figures must be viewed as loose estimates, as the wide range indicates.

11. Ministry of Agriculture and Water, *Seven Green Spikes* (Riyadh: Ministry of Agriculture and Water, 1974).

12. Abdulaziz H. al-Fahad, "The 'Imama vs. the 'Iqal: Hadari-Bedouin Conflict and the Formation of the Saudi State," in *Counter-Narratives: History, Contemporary Society, and Politics in Saudi Arabia and Yemen*, ed. Madawi al-Rasheed and Robert Vitalis (New York: Palgrave Macmillan, 2004), 35–36.

13. The Al Saud relied on the Wahhabi clergy, on whom it bestowed considerable power, to convince skeptics of the legitimacy of their message. To spread the faith, King 'Abd al-'Aziz dispatched religious missionaries known as *mutawwa'a*, religious figures who lacked the higher religious training of the more senior sheikhs but who made up for their lack of credentials with zealotry. In the twentieth century, the Al Saud helped connect the strict interpretative framework of Wahhabism—which viewed anyone who deviated from a set of narrow beliefs and rituals to be guilty of apostasy, and thereby worthy of either death or conquest—with their political aims of controlling the Arabian Peninsula.

14. The Al Saud relied on several incentives to induce permanent settlement. The *mutawwa'a* stressed that proper faith required sedentary living, a precept embodied in the name for the settlements, *hujjar* (sing. *hijra*). The choice of the word *hijra* for individual settlements was an intentional and symbolic choice, as it harkened back to the early Islamic era, specifically the Prophet Muhammad's migration from Mecca to Medina, a seminal event in the formation of Islamic belief and tradition. While Islam lent ideological substance to sedentarization, the location of *hujjar* near water resources and the potential for agriculture gave the Al Saud hope that the sedentarization program would be sustainable. In little over a decade the number of settlements jumped from one single settlement to over two hundred, with most located close to water resources spread across Najd. In addition to providing weapons for the *jihad* and building mosques and schools, the Al Saud gave the *ikhwan* money, seed, and the equipment necessary to engage in various kinds of settled agriculture.

15. John S. Habib, *Ibn Sa'ud's Warriors of Islam: The Ikhwan of Najd and their Role in the Creation of the Sa'udi Kingdom, 1910–1930* (Leiden: Brill, 1978), 16. Another significant objective was to harness but not eliminate the mobile-fighting power of the *ikhwan*. Habib notes that the military goal was to keep the *ikhwan* "mobile enough to cross the length and breadth of the peninsula, and sedentary enough to be in a specific locality when he [Ibn Sa'ud] needed them."

16. Twitchell, *Saudi Arabia*, 212.

17. Ibid.

18. Ibid.

19. Ibid., 213.

20. Ibid., 216.

21. Ibid., 219.

22. Shortly after obtaining the concession, a company for operating in Saudi Arabia was formed called the California Arabian Standard Oil Company. It would be renamed the Arabian American Oil Company in 1944.

23. *Report of the United States Agricultural Mission to Saudi Arabia* (Cairo: 1943), 1.

24. There is no indication in any of Twitchell's writings that he saw anything wrong with the expansion and consolidation of Saudi power. He certainly never wrote about local resistance to or animosity toward the Al Saud, which does not mean that he was unaware of such sentiment. His various accounts of his and the agricultural mission's work are apolitical in tone, but it is also clear from them that Twitchell understood whose political interests were being served.

25. *Report of the United States Agricultural Mission*, 46.

26. Ibid., 48.

27. Ibid., 58.

28. Michael Adas, *Dominance by Design: Technological Imperatives and America's Civilizing Mission* (Cambridge, MA: The Belknap Press of Harvard University Press, 2006).

29. Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power* (New York: Simon & Schuster, 1991); Nathan J. Citino, *From Arab Nationalism to OPEC: Eisenhower, King Sa'ūd, and the Making of U.S.-Saudi Relations* (Bloomington: Indiana University Press, 2002).

30. Letter to Sulayman al-Hamad, Assistant to the Minister of Finance, June 4, 1949. Karl S. Twitchell Papers. Public Policy Papers, Department of Rare Books and Special Collections, Princeton University Library.

II

Expanding the Nile's Watershed: The Science and Politics of Land Reclamation in Egypt

Jessica Barnes

A desert seems very different from a cultivated field. One is sandy, the other a swath of green. Yet the boundary between the desert and the sown shifts in time. Through a gradual process of watering, fertilizing, plowing, and planting, the desert can be brought into cultivation. This is the process of land reclamation. It is the conversion of a parched surface into a field of wheat, an orchard of oranges, a ground cover of clover. Egypt offers a valuable example of this landscape transformation. The stark contrast between the long-cultivated strip of the Nile Valley and Delta and the desert that abuts the fields on either side belies the transience of the border between the two. Over the last two centuries, land reclamation has reshaped the rural landscape of Egypt, increasing the territory of agricultural production.[1] Government agencies, farmers, international advisors, and foreign companies have worked to push out the boundaries of the land watered and drained by the world's longest river. They have come together in an ambitious endeavor to expand the Nile's watershed.

Histories of land reclamation in Egypt have charted the evolution of this program under different organizational regimes, highlighting the political motivations driving reclamation and the challenges reclamation projects have faced.[2] What has been largely missing from these histories, however, is the water that makes reclamation possible.[3] Water is not, of course, the only resource required to transform desert into field; other inputs are needed as well, like fertilizers and treatments to adjust soil texture. But whereas these inputs can be

easily purchased, water cannot. The fortune of any attempt to reclaim new land lies, therefore, in the supply of water it receives from the Nile.[4] The channeling of water to the desert is what allows the conversion of sand to crop; the maintenance of that flow is what prevents the reversion of crop to sand.

This chapter places water at the forefront of the story of land reclamation in Egypt. Using the World Bank's New Land Development Project as a case study, it tracks how water, as both a physical resource and an object of scientific understanding, is central to reclamation efforts. This project, which started in 1980 and was completed in 1991, transformed twenty-four thousand feddans of desert west of the Nile delta into fields.[5] Yet a mere two years after it ended, many of the new fields lay fallow. Without the water necessary to sustain the land, production dropped significantly. The World Bank changed its assessment of the project from satisfactory to marginally satisfactory; it altered its evaluation of the project's sustainability to uncertain.[6]

The success of the project in creating productive lands in the desert was ultimately constrained by its failure to secure sufficient water resources to feed those lands. The roots of this failure lay in the assumptions that project managers made about where the water would come from and how it would reach the project area. The farmers who came to settle the newly reclaimed land no doubt had their own ideas about the project's progress and the water they received. Since these voices do not, however, feature in the archival records of the project, this chapter analyzes the project from the perspectives of the government officials, World Bank staff, and external consultants who managed the project and used their expertise to guide its activities. Correspondence, consultancy reports, and project documents from the World Bank archive offer insight into the types of water knowledge that formed the conceptual foundation of the project.[7] This project was not the biggest of the internationally funded reclamation programs implemented in Egypt in the late twentieth century. Its scale was small in comparison to the government's independent initiatives to transform the desert. But access to the project's internal records provides a unique opportunity to look at how staff from the World Bank and officials from the Ministries of Agriculture and Irrigation understood Egypt's water supply and the water requirements for reclamation.

There is a long history of water manipulation and agricultural development projects around the world that have failed to meet their ambitious goals. Visions of agricultural bounty and dreams of an endless water supply are frequently unfulfilled in reality.[8] The case of Egypt's New Land Development

Project demonstrates how a project's outcome is determined, in part, by the scientific understandings that underpin the project's activities. These understandings are the result of debates between expert groups, which hold different stakes in the project's outcomes. This is not just a matter of one group of experts being right and another group being wrong, but of each group framing the resource in question and its knowledge about that resource in a particular way. As the World Bank, other international donor agencies, and national governments continue to pursue water and agricultural development projects, this analysis shows how much can be learned about past and ongoing projects from their foundational assumptions.

In line with a body of scholarship within environmental history that has highlighted the role of nonhuman actors in influencing the course of historical events, this study also reveals how it was the flow of water—or rather the lack of flow—that ultimately determined the failure of this reclamation initiative.[9] The New Land Development Project dug canals, constructed pumping stations, and installed an irrigation network. But those canals ended up half empty, the stations operating at below capacity, the distribution ditches dry. Without water, the new infrastructure was futile. This provides a valuable lesson not only for rethinking the process of land reclamation, but for reconsidering the history of other farming communities in the region and beyond. Both water and the technologies for moving, blocking, storing, accessing, redirecting, and utilizing that water, from the scale of the river basin to the field, play a central role in the development of agrarian societies.

Land Reclamation in Egypt and the New Land Development Project

Land reclamation is not new in Egypt. The Ottoman state launched a number of projects to increase the amount of taxable agricultural land in Egypt, by expanding cultivation into barren and degraded land.[10] These efforts intensified over the course of the nineteenth century as the Ottoman governor general, Muhammad Ali, and his successors launched initiatives to drain waterlogged and salinized soils in the delta and offered grants of idle (*ib'ādīya*) land to prominent individuals, exempting them from taxes on the condition that they brought it into cultivation.[11] The building of the first Aswan Dam in 1902 made additional water available, opening up new possibilities for reclaiming desert land that had never previously been cultivated. It was in the wake of the 1952 revolution, however, that the government's

TABLE 11.1 Land Reclamation in Egypt since the 1950s

1950s	1953–67	*Egyptian-American Rural Improvement Services Project*	Reclaimed 37,100 feddans in Abis, Kom Oshim, and Quta.	• Reclaimed land distributed to landless farmers.
	1953–	*Tahrir Project*	Planned to reclaim 600,000 feddans west of the delta. By 1980 had reclaimed 122,000 feddans.	
	1956	Suez Crisis stalled progress.		
1960s	1960–65	*First Five-Year Plan*	Reclaimed 390,000 feddans.	• Private land reclamation companies nationalized. • Creation of state farms in reclamation areas.
	1965–70	*Second Five-Year Plan*	Reclaimed 300,000 feddans.	
	1967	Six Day War interrupted reclamation activities.		
1970s	1970–78	Low rates of growth	Less than 50,000 feddans reclaimed.	• Progress slow due to other budgetary priorities.
	1971	Completion of the Aswan High Dam	Increased the amount of water available for agricultural expansion.	
	1978	President Anwar al-Sadat launched a "Green Revolution" with the goal of developing 2.9 million feddans of agricultural land before the end of the century.		
1980s	1980–91	*New Land Development Project*	World Bank-funded project reclaimed 24,000 feddans west of the Delta.	• Sale of state land to private investors for reclamation.
	1981	Public Law No. 143	Removed public sector's legal monopoly on reclamation, opening up reclamation to the private sector.	• Privatization of state farms. • Increasing skepticism among international donors about the economic viability of reclamation.
	1983–88	*Third Five-Year Plan*	Reclaimed 189,000 feddans.	
	1987–	*Mubarak Project for Developing and Serving the Land Allocated to Youth Graduates*	Started to distribute land in parcels of five feddans to high school or college graduates and beneficiaries (veterans and those who lost land in the 1992 tenure reform).	
	1988–93	*Fourth Five-Year Plan*	Reclaimed 656,000 feddans.	
1990s	1993–97	*Fifth Five-Year Plan*	Reclaimed 469,000 feddans.	• Increasing private sector involvement.
	1997–17	*Thirty-Year Strategy*	3.4 million feddans to be reclaimed by 2017.	

TABLE 11.1 (*Continued*)

2000s	2009–	*Agricultural Strategy Towards 2030*	1.25 million feddans to be reclaimed by 2017 and 3.1 million feddans by 2030.	• Private-public partnerships in the new lands.

Data Sources: Jon Alterman, *Egypt and American Foreign Assistance 1952–1956: Hopes Dashed* (New York: Palgrave Macmillan, 2002); Sayed Hussein et al., *Study of New Land Allocation Policy in Egypt*, Report No. 65, Agricultural Policy Reform Program (Cairo: Ministry of Agriculture and Land Reclamation, 1999); Pamela Johnson et al., *Egypt: The Egyptian American Rural Improvement Service, a Point Four Project, 1952–63*, AID Project Impact Evaluation No. 43 (Washington, DC: USAID, 1983); Günter Meyer, "Economic Changes in the Newly Reclaimed Lands: From State Farms to Small Holdings and Private Agricultural Enterprises," in *Directions of Change in Rural Egypt*, ed. Nicholas Hopkins and Kirsten Westergaard (Cairo: American University in Cairo Press, 1998); A. Nyberg, S. Barghouti, and S. Rehman, *Arab Republic of Egypt Land Reclamation Subsector Review*, Report No. 8047 (Washington, DC: World Bank, 1990); Robert Springborg, "Patrimonialism and Policy Making in Egypt: Nasser and Sadat and the Tenure Policy for Reclaimed Lands," *Middle Eastern Studies* 15 (1979): 49–69; Sarah Voll "Egyptian Land Reclamation Since the Revolution," *Middle East Journal* 34 (1980): 127–148 ; T. Zalla et al., *Availability and Quality of Agricultural Data for the New Lands in Egypt*, Impact Assessment Report No. 12, Agricultural Policy Reform Project (Cairo: Ministry of Agriculture and Land Reclamation, 2000).

land reclamation program took off. Driven by an aspiration to expand the cultivated area, increase agricultural production, and create new jobs for farmers and laborers, the government launched a set of ambitious five-year plans. Construction of the Aswan High Dam in the 1960s further increased the amount of water available for irrigation, generating the potential for even more expansion.

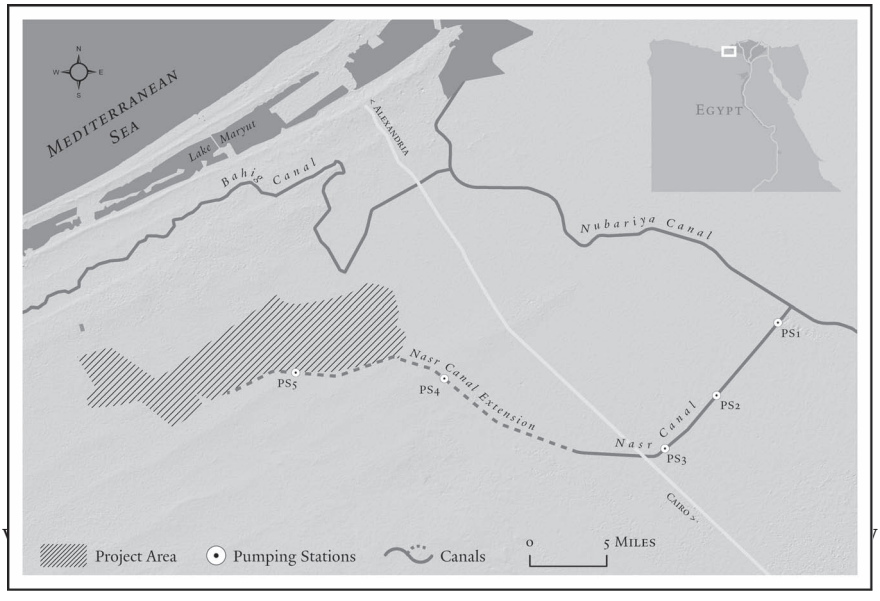
While the governments of Anwar al-Sadat (1970–1981) and Hosni Mubarak (1981–2011) continued to promote land reclamation, the 1970s and early 1980s were a time of increasing doubt within the international donor community, which provided an important source of funding to Egypt's agricultural sector, about the viability of transforming desert into fields. These concerns were bolstered by a study commissioned in 1980 by the U.S. Agency for International Development (USAID), which concluded that "large-scale reclamation of new desert lands in Egypt can take place only at considerable cost to the economy."[12] The authors found that the reclamation of land where farmers must pump the water up more than twenty meters had a negative rate of return, due to the high energy costs of lifting the water. In fact, their models only produced positive economic results "under the most heroic assumptions regarding yields."[13] The report was highly controversial; according to one source, it "soured relations with the MOLR [Ministry of Land Reclamation]," which was "extremely displeased."[14]

In October 1977, the World Bank sent a reconnaissance mission to Egypt to look for new lending opportunities in the agricultural sector. The bank was keen to increase its lending to Egypt as a mechanism to gain leverage in Egypt's political economy and push for liberal reforms.[15] The mission found that

reclamation was one of the government's top agricultural priorities. Indeed President Sadat was on the eve of launching his bold "Green Revolution," designed to reclaim 2.9 million feddans of desert land by the end of the century.[16] Up until this point, the bank's position had been that the Egyptian government should focus on improving the situation in existing lands rather than expanding into new ones. The mission recognized, however, that reclamation was an area where the government would welcome bank funding. After much debate, senior bank officials came to a decision that they should reverse their "hands off stance" on new land projects.[17] A number of staff remained skeptical, but they realized that whatever their position, the Egyptian government would press ahead with this program. As one bank official commented, "New land development is going to take place in Egypt, whether we like it or not. And sooner or later the bank is bound to be involved in such projects. If we participate early we may help the Egyptians to avoid costly mistakes."[18] This change of position was supported by the bank's assessment that reclamation could be economically viable. Having conducted their own studies, bank staff came to the conclusion that the USAID study was "excessively pessimistic" and that their proposed reclamation project would have a positive rate of economic return.[19]

The New Land Development Project marked the bank's first foray into irrigation and land reclamation work in Egypt. The project's primary goal was to develop twenty-four thousand feddans of land west of the Nile through a reclamation and smallholder resettlement project.[20] Project implementation met with problems from the outset; what was meant to be a six-year project ended up taking eleven. The project's goal to develop a training farm failed, in part because the land that the government allocated to the farm did not have a source of irrigation water.[21] The agricultural extension program, which was to provide settlers with information on the most suitable crop rotations, never materialized.[22] Despite these problems, by 1991 the project had succeeded in its goal of reclaiming around twenty-four thousand feddans. "The area has changed from a barren desert into an oasis," the project completion report concluded.[23] The government's evaluation was even more effusive. "The project is a success in all aspects," the borrower's response section of the completion report stated. "The project is considered as one of the most successful projects in Egypt and ever in the whole region. It is one of the ideal projects in the field of land reclamation."[24]

However, a critical weakness at the heart of the project was soon revealed. There was not enough water to irrigate the new land. When bank staff carried out a performance audit mission in 1993 they found extensive areas of project land left fallow. The cropping intensity in the summer was low. Production



MAP 11.1. New Land Development Project

water supplies are reducing benefits," the evaluation team stated unequivocally.[25] The origins of this problem, which were manifest a mere two years after the project came to a close, can be found in three of the project's key assumptions. The first was an assumption about how much water the new lands would require; the second was an assumption about where that water would come from; and the third was an assumption about how much water was available. In forging these assumptions, the Egyptian and expatriate experts produced and contested a set of scientific understandings at the level of the feddan, canal, and basin about how water would be used for desert transformation. These understandings were not just about contrasting scientific judgments but reflected the broader political and economic stakes that the different experts held in the project's success. The project's failure to attain sustainability ultimately lay in the limitations of these negotiated understandings.

Calculating Demand: How Much Water Does a Desert Feddan Need?

The plan to reclaim twenty-four thousand feddans was underpinned by a calculation of how much water each new feddan would require. This was partly a question of how much water would be needed for the reclamation process. To turn

desert land into cultivable soil, water must be washed through the soil to leach salts out of the top layers and reduce them to tolerable salinity levels. Preliminary field trials, conducted by a British consultancy firm in 1979 and 1980, found that the soils in the area were easily leachable and that high yields could be obtained from the first year of cropping. Based on these results, the project staff assumed a primary leaching of one meter, which meant that each new field would be inundated up to a meter in depth as part of the reclamation process.[26] They predicted that in subsequent years the deep percolation of about 20 percent of the water applied to the soil would be sufficient to remove accumulated salts, so no further applications specifically for leaching would be required.[27]

The next step was to assess how much water the crops would need once those soils were planted. This was done by ascertaining how much water a "reference crop" would evapotranspire (conduct to the atmosphere by evaporation from plant surfaces and transpiration through the leaves) under the climatic conditions in that location, and then multiplying that figure by a crop factor to represent the crops that would actually be planted. The British consultants preparing the feasibility study used a theoretical method known as the Blaney Criddle, as modified by the Food and Agriculture Organization (FAO) of the United Nations, to calculate reference crop evapotranspiration with data from the South Tahrir climate station.[28] They then adjusted this value based on a coefficient to reflect crop characteristics. Since the farmers within the project were going to be allowed to choose what to cultivate—which meant that cropping patterns were unknown—the consultants applied a mean crop factor of 1.05 based on data from the FAO. This figure was an average coefficient that reflected the most commonly grown crops' peak water requirements in July.[29]

Finally, the project planners had to account for the fact that some water would be lost as it passed through both the distribution network and the fields. The consultants estimated that the efficiency of the conveyance system would be quite high at 0.93, meaning that only 7 percent of the water that entered the canals would be lost to evaporation or leakage before reaching the fields. In terms of the field-level irrigation efficiency, this depended on the method of irrigation farmers would use. The Ministry of Irrigation had a policy that farmers use sprinkler or drip irrigation on all new lands, but initial field trials had indicated that the more commonly used technique of flood irrigation would actually be more appropriate in the project area. Not only are sprinklers expensive to install, operate, and maintain, but few of the smallholder settlers would be familiar with their use. In addition, the trials showed that contrary to expectations, the efficiency of water use was lower with sprinkler irrigation. On fields where they used sprinklers, consultants found that a soil crust developed which caused up to 40 percent of the water

applied to runoff over the surface.[30] Combined with high rates of evapotranspiration losses, the trials concluded that sprinkler irrigation's efficiency was a mere 0.5 in comparison to flood irrigation's 0.65.[31] Government officials remained skeptical that the method which they understood to be more efficient could, in this case, be less so. But the bank staff were adamant that flood irrigation be used and adopted the figure of 0.65 as their estimate of field-level efficiency.

Combining these three factors, the feasibility study therefore determined that each feddan would need a peak of fifty-four cubic meters of water a day in July.[32] This was substantially more than Egyptian officials thought a feddan needed. Indeed government engineers had designed the Nasr Canal, from which the project was to draw its water, to irrigate 300,000 feddans based on an assumption that the peak water requirement would be only thirty-three cubic meters of water per feddan each day.[33] It was not surprising, therefore, that the calculation of water duty should be hotly contested.

A few months after the consultancy firm submitted its feasibility study, the irrigation subcommittee for the project, comprising two senior officials from the Ministry of Land Reclamation, an irrigation engineer from the World Bank, and an external consultant, met to revise the water duty to be "less conservative."[34] First, they adopted the original rather than the modified Blaney Criddle method to calculate reference evapotranspiration. The Egyptian members of the committee asserted that based on experiments carried out at a nearby research station, this method would give more realistic (and lower) results. Second, they argued that the climate data from South Tahrir was too extreme. Located fifty kilometers southwest of the project, the station is in a hotter environment where crop water requirements, as a result, are higher. The committee recommended using figures from North Tahrir station, situated close to the project area, averaged with data from the Borg al-'Arab station, located in a slightly milder environment on the Mediterranean coast. Third, the committee increased the conveyance efficiency to 0.94, on the basis that not only the main canals but also the tertiary canals would be lined. By making these adjustments, the committee brought the figure of water duty down to forty-eight cubic meters per feddan each day.[35]

Furthermore, committee members identified two characteristics of the project area that they argued would reduce the water duty. The first was the fact that part of the project lands would be irrigated with sprinklers, which—despite the field trial results—committee members assumed to have a lower water requirement (of 36.4 cubic meters per feddan each day). The second was the fact that some of the project land would be planted with trees, which require less water than field crops (typically only thirty-one cubic meters per

feddan each day). By taking these factors into consideration, they calculated an average water duty of just forty-six cubic meters per feddan each day, in contrast to the initial fifty-four cubic meters. In addition, they pointed out that about a quarter of the land would be under villages, roads, canals, and drains, and thus not require any water at all; thus, the water duty for the project as a whole would be only 34.4 cubic meters per feddan each day. By changing the method of calculation and the assumptions on which that calculation was based, this group of Egyptian and foreign engineers therefore concluded that each feddan would need only 64 percent as much water as the British consultants originally anticipated.[36]

The bank was only willing, however, to accept a reduction in the water duty up to forty-eight cubic meters per feddan each day. Bank staff rejected further revisions since they said that no provisions had been made in the project for tree crop cultivation or sprinkler irrigation and that non-agricultural areas would be excluded from the project area.[37] A figure of forty-eight cubic meters per feddan each day was therefore adopted as the project design guideline. Although the Ministry of Irrigation gave an assurance at the time of project negotiations that it would supply this water, many government officials remained skeptical that this volume was really necessary. One bank consultant noted that "Mr Makhlouf [Undersecretary] of the Ministry of Irrigation has still some reservations about this demand."[38] Other questioning voices came from the Ministry of Land Reclamation, where engineers challenged the use of FAO data on crop water requirements. Arguing that crop coefficients should be based on local experience instead, they recalculated peak water requirements as being only 43.4 cubic meters per feddan each day, based on the inclusion of the local 130-day maize variety, rather than the 100-day variety included in the initial estimates.[39]

This difference in opinion between the government officials and international consultants can be explained by the two groups' contrasting stakes in the project. To the government officials, the decision about how much water was needed to reclaim the project lands carried with it a much broader significance. It helped to define the feasibility of the government's plans to expand the nation's cultivated area by hundreds of thousands of feddans. If they agreed that more water was needed to reclaim each feddan, it would mean that the government's ambitious reclamation plans would require a far greater volume of water than what was available, thereby undermining their vision of national progress through agricultural expansion. These issues may not have been openly discussed in meetings between government officials and project staff, but they were acknowledged in internal project documents. In a "back-to-office report," for example, the bank official cited

above noted that the undersecretary's reservations about raising the water requirements for reclamation were "due obviously to political reasons." He added, by means of explanation, that "the government several times has announced an ambitious plan for expansion of irrigation, based on a much lower water demand per feddan."[40] For the international consultants, on the other hand, their key concern was the productivity of the twenty-four thousand feddans within the project area. If those feddans flourished, it would reflect well on them and on the bank's development program. From their perspective, therefore, it was better to plan to accommodate the maximum volume of water that the land would need during the time of peak water requirements.

Government officials were hence caught between meeting the demands of the project and fulfilling the vision of the politicians. In light of this fact, it is not altogether surprising that they ultimately failed to fulfill their commitment to supply the project lands with the volume of water set by the bank staff at the outset.

Tracing Flows: Where Would the Water Come From?

The water that the government assured the project consultants it would supply each year was to come from a twenty-eight-kilometer extension to the existing Nasr Canal. For the water to reach the project site, two new pumping stations would be needed to lift water from the canal up forty-three to fifty-five meters to the higher desert land. Even before the project started, the government, keen to develop new lands in this area, had begun to extend the canal and install the pumping stations. Although there were a number of delays in the construction work, the extension was complete by late 1983 and the final pumping station started operating in 1986.[41]

The project consultants were concerned, however, about the poor state of repair of the first twenty-two-kilometer section of the Nasr Canal. Built in 1971, the canal's walls were deteriorating and its concrete lining was broken. The Ministry of Irrigation promised that the rehabilitation would be completed by the end of 1983, but as it had not begun this work when the project negotiations were underway, some within the bank were dubious. If the canal collapsed, no water would be able to flow to the project site and reclamation would be impossible. Bank staff called for the signing of the project agreement to be postponed until the ministry had found contractors to repair the canal.[42] The ministry put out a tender for repair work and received two bids, but it rejected both on account of their "unreasonably high cost."[43] In the end, the bank

capitulated, agreeing in October 1981 to move forward with the project based only on government assurance that the repair work would be carried out.[44]

At the same time, bank staff working on the project called for intervention at the highest levels to pressure the government into proceeding with the work. In November 1981, the director of the bank's department for the Middle East region sent a letter to the minister of irrigation about the progressive deterioration of the canal. "If serious damage and deterioration of the canal have occurred with the present regime," he wrote, "one can easily imagine what disastrous effect the higher flow and velocity [required as new lands are developed along the canal] will have on the banks of the canal already damaged by the forces of erosion. Our considered judgment on the matter is that a collapse of the canal cannot be ruled out. This would have serious financial and social consequences which, I am sure, you are keen to avert."[45]

Despite the bank's efforts to galvanize swift action on this matter, it was not until the middle of 1983 that the government finally authorized two contracts for the repairs.[46] Work started in early 1985, but the contractors met a number of technical difficulties that delayed their progress. By April 1987, one contract was 40 percent complete, the second only 24 percent.[47] Even when the project came to a close, sections of the canal were still in a poor state of repair.[48] The project completion report highlighted the canal's damaged condition as the largest risk to the project's sustainability. "Part of the Nasr Canal, the lifeline of the project, remained in need of urgent repair," the report stated. It continued, "Although some rehabilitation work was started, much more work remains to be done to ensure adequate irrigation water delivery to the project area in the future."[49]

The failure to mend the canal lay partly in the challenge of carrying out complex repair work while not interrupting the flow of water through the canal. But it also lay in the fact that the Egyptian engineers differed from the expatriate engineers in their evaluation of the urgency of this maintenance work. When the minister of irrigation visited Washington during the early stages of the project, he maintained that "even without repairs, the canal could carry a sufficient amount of water to service the New Lands Project." He argued that the first priority was to complete the extension of the canal.[50] The bank official overseeing the project had a different view. "To my mind," he wrote, "there is no need to complete the end of the canal when there is a risk that nothing will pass through the first part."[51] As the project progressed, government officials continued to express ambivalence about the necessity of this repair work. While this position may in part have been due to a judgment that the canal's status posed no threat, it could also have reflected the budgetary constraints that the ministry faced during this period as the economic situation worsened

in Egypt.[52] In a time of limited funds (but still ambitious goals), it is not surprising that the ministry was unwilling to spend its money on repair work that it did not deem to be absolutely essential. The government's response to the project completion report rejected the bank's concerns, asserting that "efforts have been directed to ensure the repair of any damage to the lining of this canal and to assure its full maintenance . . . minimizing the risk of water supply failure from this canal and hence the sustainability of the project is guaranteed."[53]

Although the disagreement over the significance of the repair works remained unresolved right up to the end of the project, by the time of the follow-up mission in 1993, the level of water in the canal was so low that its poor state of repair posed little problem.

Spreading Water Thinly: How Much Water Was Available?

According to its design specifications, the Nasr Canal could supply 118 cubic meters of water a second. This volume would be sufficient to irrigate from 270,000 feddans to over 370,000 feddans, depending on how much water each feddan required.[54] Since at the time of project development the government had only committed to irrigating 218,000 feddans along the canal, including the new project, neither bank staff nor government officials anticipated water shortage problems.[55] The project's feasibility study stated unequivocally that "the availability of water is not a constraint to the development of irrigated agriculture in the project area."[56]

But water availability is not merely a function of the size of the canal that supplies the water. It is also a question of how much water government officials choose to direct into that part of the water distribution system. For 118 cubic meters of water to flow into the Nasr Canal each second, government engineers had to make particular decisions about water distribution at a number of points farther up the irrigation network. The Nasr Canal draws from the Nubariya Canal, which in turn draws from the Rayah al-Behera and Rayah al-Nasseri, which lead off from the Nile just upstream of the Delta Barrages (see figure 11.1). At each of these junctions in the irrigation network, officials from the Ministry of Irrigation determine how much water should go into each branch of the system, adjusting the gates of regulators or weirs accordingly. Tracing the flow back farther, the amount of water available in the Nile at the Delta Barrages is linked to how much water farmers draw off upstream, the government's releases from the Aswan High Dam, and the amount of rainfall in the East African source regions of the Nile. So the presumption that the Nasr Canal

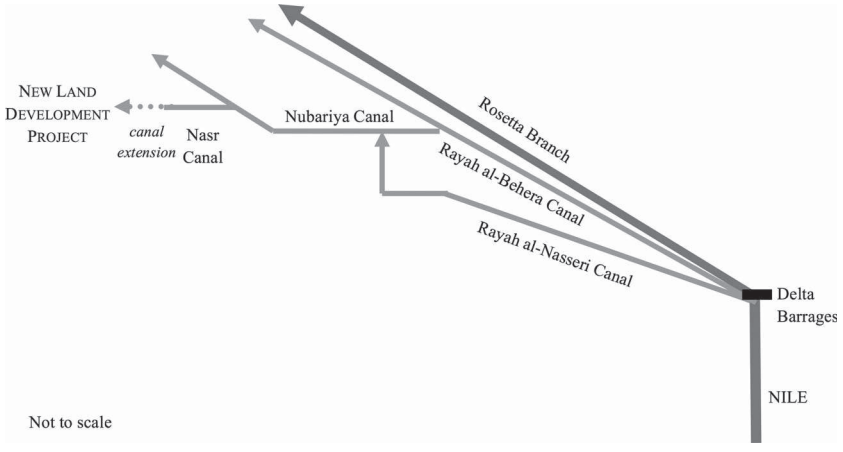


FIGURE 11.1. New Land Development Project Schematic Diagram

would always be able to operate at its maximum capacity, constantly delivering 118 cubic meters of water per second, was quite optimistic.

The bank staff recognized that part of the project's success in securing an adequate irrigation water supply hinged on increasing the flow through the Nubariya Canal.[57] This was something that the Ministry of Irrigation was already in the process of doing, as it knew that there would be an increasing demand for water in the area served by the canal. In 1980, the flow through the canal was 12.5 million cubic meters per day, just over half its design discharge of 22.5 million cubic meters per day. To increase the canal's inflow to fifteen million cubic meters per day, the ministry was working to enlarge the Rayah al-Nasseri.[58] By the middle of 1982, twelve dredgers were at work and had expanded the canal along 45 percent of its length; the remainder was expected to be complete by June 1983.[59] There is no reference in the archival record to suggest that this work was delayed. Thus it was most likely finished by 1983, before water started flowing to project lands.

However, acknowledgment of the need to increase the flow through the Nubariya Canal was the only indication in the project preparation documents that something would need to change within the broader system of water distribution to secure water for new land development. Indeed, the project was founded on the idea that there was in fact *too much* water. As one bank irrigation specialist wrote, "There are millions of feddans of undeveloped land in Egypt which should (and can) be developed to utilize surplus waters now available in the Nile River to provide a livelihood for a growing population."[60] Thus, far from anticipating water shortages, the project forecast that the supply would increase in the future, meaning that the government could pursue additional

reclamation initiatives along the Nasr Canal in later years. Based on this prediction, project consultants recommended that the extension to the Nasr Canal be constructed at a capacity greater than necessary for the current project, to allow for subsequent expansion.[61]

Over the course of the 1980s, though, there were growing concerns among bank staff that there might not be enough water for further reclamation. These concerns were exacerbated by a string of low rainfall years from the late 1970s through the mid-1980s in the source regions of the Nile, which led to reduced Nile flows and mounting pressure on the national water supply.[62] In 1983, a bank report came to the conclusion that the availability of water would soon become a constraint in the new lands. The report judged that the government's plans to develop new lands were "overambitious, not to say unrealistic."[63] An internal bank memorandum from 1984 noted that "although it is not possible to define precisely when water will become a limiting factor in absolute terms [for new land development], two phases can be anticipated: a shortage of water during the peak demand period in the summer caused by conveyance constraints in the Nile and canal distribution system, to be followed later by an overall shortage of water."[64] Bank officials tried to raise these concerns with Egyptian officials but found them generally unwilling to heed their words of warning. Government officials were, of course, acutely aware of the fact that Nile flows had been low for a number of years and that storage supplies in their main reservoir of Lake Nasser were nearing a critical point. However, publicly acknowledging this serious point of vulnerability was politically unacceptable.

In the later years of the project, some water shortages became apparent in the newly developed lands. In 1986 and 1987, the level of water in the Nasr Canal fell, leaving parts of the canal system nearly dry. A report from July 1987 stated that "serious crop losses have resulted."[65] During this period, a number of farmers who had settled in the project area traveled to the nearby city to complain to the resident engineer about the inadequate water supply.[66] But bank staff judged these water shortages to be due more to problems of water distribution than fundamental resource insufficiency. They recommended modifications to the weirs and offtakes to ensure that each part of the distribution system would receive water even when the supply was low. These adjustments seem to have been successful since the final years of the project saw no further complaints of shortages.[67]

Just two years after the project came to an end in 1991, though, the availability of water was in doubt. When bank staff visited the region to conduct a performance audit, they found that the flow of water through the Nubariya Canal was insufficient during the summer to allow the Nasr Canal to operate at

its design capacity. Summer supplies were so low that irrigation managers were only able to provide water to the canals in the project area once every two weeks rather than once a week. The water level in the canals was up to ninety centimeters below the design level, meaning that engineers had to reconstruct the offtakes so that water would still be able to flow out of the canals to the fields. This shortage cannot be explained by the status of the broader Nile system; by the early 1990s rainfall had increased in the river's source regions and flows had rebounded. Rather, what had evidently happened was that government officials had stopped channeling the same volume of water into these branches of the irrigation network as they had previously. The bank report noted that "the New Lands project has been undermined by the government's policy of spreading water thinly (for social and political reasons)." It continued with its prognosis: "The long range water duty figure used by the government is well below the figure used to design the project, and therefore the current realistic prospect is that the scheme will have to adjust for the foreseeable future to water supplies much below the level expected."[68]

Watering the Desert

Thus the confluence of three assumptions—about how much water was needed, where the water would come from, and how much water was available—led to a situation, shortly after the project came to an end, in which much of the newly developed land lay fallow. Without water, the new land could not flourish.

These three assumptions were the outcome of heated debates between Egyptian and expatriate experts, waged in project memoranda, reports, and letters. The debates revolved around the question of accessing water for new land development. They focused on the science of how much water was required to reclaim the desert. Yet they were about more than just water. They were about the relations between an international funding institution that wanted to push a particular reform agenda and a national government that needed funds to finance its activities but had its own set of interests, between politicians who saw a vision for a future greener Egypt and government officials who were tasked with implementing those visions, and between international consultants whose immediate concern was to ensure their project's success and ministry staff who had to meet their government's political and budgetary priorities.

The case of the New Land Development Project, therefore, offers useful insights into ongoing efforts to expand the Nile's watershed. Although the international donors have largely withdrawn from active engagement in new

land development, the Egyptian government continues its reclamation program. In the south of the country, the Toshka Scheme channels water fifty kilometers from Lake Nasser into the Western Desert to cultivate what the government hopes will eventually be over a half million feddans. In the north, the El-Salam Canal channels water into the Sinai Peninsula with the goal of reclaiming 620,000 feddans of desert. All along the boundaries of the agricultural zone, through both government projects and independent initiatives, farmers are extending their lands out into the desert. But where will the water come from to irrigate all this new land? How much land can the Nile irrigate? Who gets to make this decision? How do recent theories about climate change and its impact on East African rainfall patterns alter the debates over water availability and the potential for desert development? What will happen in the future if other Nile Basin countries build large dams and modify the volume of water Egypt receives from the river?

As the Egyptian government looks to expand the Nile's watershed even farther—by 3.1 million feddans by the year 2030—questions about where the water will come from to feed that expansion are paramount.[69] Understanding how water flows through canals and soil will be critical if that ambitious goal is to become a reality, and most significantly, if those fields are to be sustained into the future.

Acknowledgment

I thank the staff of the World Bank archives for helping me access records from the New Land Development Project. I also thank David Kneas, Alan Mikhail, and two anonymous reviewers for their insightful comments on drafts of this chapter.

Notes

1. While the term *land reclamation* (*istiṣlāḥ*) can refer to a range of activities, including draining marshlands or transforming saline soils, land reclamation in Egypt since the middle of the twentieth century has been primarily about cultivating the desert. In this sense, the term is something of a misnomer, since it is not a process of *re*-claiming something that has been lost but of creating something new.

2. J. Tony Allan, "Some Phases in Extending the Cultivated Area in the Nineteenth and Twentieth Centuries in Egypt," *Middle Eastern Studies* 19 (1983): 470–481; Jon Alterman, *Egypt and American Foreign Assistance 1952–1956: Hopes Dashed* (New York: Palgrave Macmillan, 2002), 63–95; Günter Meyer, "Economic Changes

in the Newly Reclaimed Lands: From State Farms to Small Holdings and Private Agricultural Enterprises," in *Directions of Change in Rural Egypt*, ed. Nicholas Hopkins and Kirsten Westergaard (Cairo: American University in Cairo Press, 1998), 334–357; Robert Springborg, "Patrimonialism and Policy Making in Egypt: Nasser and Sadat and the Tenure Policy for Reclaimed Lands," *Middle Eastern Studies* 15 (1979): 49–69; Sarah Voll, "Egyptian Land Reclamation Since the Revolution," *Middle East Journal* 34 (1980): 127–148; William Willcocks, *Egyptian Irrigation*, 2nd edn. (London: E. & F. N. Spon, 1899), 238–254.

3. One exception is Jeannie Sowers's analysis, which discusses the "ecological critiques" of land reclamation regarding whether or not there is actually a sufficient quantity and quality of water available from the Nile for agricultural expansion. Jeannie Sowers, "Remapping the Nation, Critiquing the State: Environmental Narratives and Desert Land Reclamation in Egypt," in *Environmental Imaginaries of the Middle East and North Africa*, ed. Diana K. Davis and Edmund Burke III (Athens: Ohio University Press, 2011), 158–191.

4. Irrigation is the only source of water for agriculture, since rainfall is so low throughout Egypt (with the exception of a small area along the Mediterranean Coast where rain-fed agriculture is possible). Reclamation also takes place in the Western Desert and Sinai Peninsula, drawing on deep groundwater, but this chapter focuses on reclamation based on Nile water.

5. The feddan is the unit of area measurement in Egypt. One feddan is equal to 0.42 hectare or 1.04 acres.

6. Robert Picciotto and H. Eberhard Köpp, *New Land Development Project, Egypt: Performance Audit Report,* Report No. 13275 (Washington, DC: World Bank, 1994), xvii–xviii.

7. All archival references are from the World Bank Group Archives (WBGA) in Washington, DC. The analysis draws from four boxes within the WB IBRD/IDA 01 Country Operation Files 1946–1998. For brevity, the fond is omitted and reference is made only to the box number (which is followed by the letter "B"). Three types of records are used: correspondence records (from files titled "Credit 1083, New Land Development Project"), monthly reports (from files titled "New Land Development Project-MR"), and quarterly reports (from files titled "New Land Development Project-QR"). These sources are referred to, respectively, as CR, MR, and QR with the relevant file number.

8. See, for instance, James C. Scott's analysis of the limited success of efforts to introduce a model of modern, scientific agriculture in the developing world. James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven, CT: Yale University Press, 1998), 262–306. For an example of the ecological and social costs of attempts to manipulate rivers for irrigation and urban use, see Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (New York: Pantheon Books, 1985).

9. On the significance of nonhuman actors in historical narratives, see, for example, Timothy Mitchell's analysis of the role of mosquitoes, fertilizers, and dams in mid-twentieth-century Egyptian development. Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002),

19–53. See also Nancy Reynolds's account in this volume of how the physical nature of stone influenced the construction of the Aswan High Dam.

10. On late seventeenth- and eighteenth-century land reclamation in Egypt, see Alan Mikhail, *Nature and Empire in Ottoman Egypt: An Environmental History* (Cambridge: Cambridge University Press, 2011), 66–71.

11. On nineteenth-century land reclamation in Egypt, see Allan, "Some Phases in Extending the Cultivated Area"; Gabriel Baer, *A History of Landownership in Modern Egypt, 1800–1950* (London: Oxford University Press, 1962); Kenneth M. Cuno, *The Pasha's Peasants: Land, Society, and Economy in Lower Egypt, 1740–1858* (Cambridge: Cambridge University Press, 1992); Willcocks, *Egyptian Irrigation,* 238–254.

12. Leon Hesser et al., *New Lands Productivity in Egypt: Technical and Economic Feasibility Study* (Washington, DC: Pacific Consultants, 1980), i.

13. Ibid., 23.

14. Jennifer Bremer, *New Lands Concept Paper II: Rethinking an AID Assistance Strategy for the New Lands of Egypt* (Cairo: Development Alternatives, Inc., 1981), 8.

15. Robert Springborg, *Mubarak's Egypt: Fragmentation of the Political Order* (Boulder, CO: Westview Press), 256.

16. Meyer, "Economic Changes in the Newly Reclaimed Lands," 334.

17. WBGA, 125456B, CR 901228, "Investment Possibilities in the 'New Lands,'" Memo Donovan to Files, December 22, 1977.

18. WBGA, 125456B, CR 901230, "New Land Development," Memo Maiss to Köpp, April 1, 1980.

19. WBGA, 125456B, CR 901231, "New Lands Project," Memo Naylor to Haynes, June 17, 1980.

20. The project also included a bilharzia control program, which this chapter does not discuss.

21. World Bank, *New Land Development Project: Project Completion Report*, Report No. 10631 (Washington, DC: World Bank, 1992), 4.

22. Ibid., 5.

23. Ibid., 6.

24. Ibid., 24.

25. Picciotto and Köpp, *Performance Audit Report*, cover memorandum.

26. WBGA, 72424B, 84541, "Feasibility Study of West Nubariya Extension Reclamation and Settlement Project—Final Report," Volume 3, Annexes 3 and 4, ULG Consultants Limited, August 1979, 19.

27. Ibid., 22.

28. Ibid., 12.

29. WBGA, 66892B, MR 1227169, "Progress Report for the Period 26 April–26 May 1980," Halcrow-ULG Ltd.

30. WBGA, 72424B, 84541, "Feasibility Study," Volume 3, 29.

31. WBGA, 125456B, CR 901232, Back-to-Office Report, Economides, September 16, 1980, 6.

32. WBGA, 72424B, 84541, "Feasibility Study," Volume 3, 5.

33. Ibid., 3.

34. WBGA, 125456B, CR 901230, "West Nubariya Extension: Reclamation and Settlement Project Feasibility Study," Memo ULG Consultants Ltd, October 1, 1979, 4.

35. Ibid.

36. Ibid.

37. WBGA, 125456B, CR 901231, Letter Naylor to Lloyd, June 12, 1980.

38. WBGA, 125456B, CR 901232, Back-to-Office Report, Economides, September 16, 1980, 1.

39. WBGA, 66892B, MR 1227169, "Progress Report for the Period January 1982," Halcrow-ULG Ltd, B2.

40. WBGA, 125456B, CR 901232, Back-to-Office Report, Economides, September 16, 1980, 1.

41. WBGA, 125456B, CR 901241, Letter Lloyd to van Tuijl, September 5, 1986.

42. WBGA, 125456B, CR 901231, Telex Naylor to Makhlouf, August 4, 1980.

43. WBGA, 125456B, CR 901232, Back-to-Office Report, Economides, January 12, 1981.

44. WBGA, 125456B, CR 901233, "NLDP: Declaration of Effectiveness," Memo Karaosmanoglu to Köpp, October 1, 1981.

45. WBGA, 125456B, CR 901233, Letter Picciotto to Samaha, December 22, 1981.

46. WBGA, 125456B, CR 901237, Supervision Report, Economides, January 10, 1984.

47. WBGA, 125456B, CR 901242, Project Execution Report, van Tuijl and Fuad, April 1987.

48. A number of recent works of environmental history have highlighted the often overlooked role of the laborers who build and maintain irrigation canals. Alan Mikhail, for example, provides a detailed analysis of how the organization of repair works on irrigation canals in Egypt changed between the late seventeenth and early nineteenth centuries, linking this to the emergence of new conceptions of population and society. Mikhail, *Nature and Empire in Ottoman Egypt,* 170–200. See also Julie Greene, *The Canal Builders: Making America's Empire at the Panama Canal* (New York: Penguin Press, 2009) for an interesting account of the multinational workforce that built the Panama Canal. In the case of the canal extension and repair works carried out for the New Land Development Project, however, labor does not seem to have been a key issue. Indeed there is no mention within the archival record of who actually implemented the work on the canals. Instead, it is clear from the records that the disagreement between bank and government officials hinged on the selection of the contractors, whom they ultimately held responsible for the quality of the work, rather than the laborers per se.

49. World Bank, *Project Completion Report,* 9.

50. WBGA, 125456B, CR 901233, "Meetings with Eng. Samaha, Minister of Irrigation and Sudan Affairs, November 16 and 17, 1981," Memo Swayze to Files, November 20, 1981, 2.

51. WBGA, 125456B, CR 901233, "Briefing Note," Memo Naylor to Picciotto, November 17, 1981, 2.

52. Nadia Farah, *Egypt's Political Economy: Power Relations in Development* (Cairo: American University in Cairo Press, 2009), 80.

53. World Bank, *Project Completion Report,* 20.

54. WBGA, 66892B, MR 1227169, "Progress Report for the Period November 1982," Halcrow-ULG Ltd, B19.

55. P. Economides et al., *New Land Development Project: Staff Appraisal Report,* Report No. 3010 (Washington, DC: World Bank, 1980), 7.

56. WBGA, 72424B, 84521, "Feasibility Study," Volume 1, Main Report and Summary, 34.

57. WBGA, 125456B, CR 901230, "New Lands Development Project—Issues Paper," Memo Economides et al. to Naylor, February 22, 1980.

58. P. Economides et al., *Staff Appraisal Report,* 7.

59. WBGA, 125456B, CR 901233, Supervision Report, Economides, May 28, 1982.

60. WBGA, 125456B, CR 901231, "NLDP Yellow Cover Review Comments," Memo Hotes to Baum, June 19, 1980.

61. Economides et al., *Staff Appraisal Report,* 17.

62. Declan Conway and Mike Hulme, "Recent Fluctuations in Precipitation and Runoff Over the Nile Sub-Basins and their Impact on Main Nile Discharge," *Climatic Change* 25 (1993): 127–151.

63. World Bank, *Selected Issues in Agriculture, Irrigation, and Land Reclamation,* Report No. 4013 (Washington, DC: World Bank, 1983), 19.

64. WBGA, 125456B, CR 901237, "5 Year Plan Investment Review in Land Reclamation," Memo Quicke to Ramasubbo, February 10, 1984.

65. WBGA, 66891B, QR 901225, "Quarterly Report for the Three Months Ending 31 July, 1987," Halcrow-ULG Ltd.

66. WBGA, 66891B, QR 901225, "Quarterly Report for the Period Ending 30 April, 1986," Halcrow-ULG Ltd.

67. WBGA, 66891B, QR 901225, "Progress Report 10," Halcrow-ULG Ltd, March 31, 1988, 9.

68. Picciotto and Köpp, *Performance Audit Report,* xvii.

69. Ministry of Agriculture and Land Reclamation, *Sustainable Agricultural Development Strategy Towards 2030* (Cairo: MALR Committee on Agricultural Research and Development, 2009).