MINING WATER FOR THE REVOLUTION: MARTE R. GÓMEZ AND THE BUSINESS OF AGRARIAN REFORM IN “LA LAGUNA,” MEXICO, 1920s TO 1960s

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In this paper I examine the little explored historical relationship between advances in “eco-technical” knowledge of Mexico’s scarce and fragile water resources and the state developmental imperatives of agrarian reform from the 1920s to the 1960s. In particular, I focus on how this relationship played out in the Comarca Lagunera of north-central Mexico, which was the emblematic region of Cardenista agrarian reform in the 1930s. Drawing on primary documentation, technical journals, newspapers, and secondary sources, I argue that the key actor in this history, hydraulic engineer-agronomist and Secretary of Agriculture Marte R. Gómez, epitomized the contradictions among advances in scientific understanding of Mexico’s hydrology, agricultural development, and business. I further contend that these contradictions were at the heart of Mexican agrarian reform and its long-term ecological as well as social and economic unsustainability.

En este artículo examino la poco explorada relación entre los avances en el conocimiento “eco-técnico” de los escasos y débiles recursos hídricos de México y los imperativos estatales de desarrollo asociados con la reforma agraria entre los años 1920 hasta los 1960. En particular, me concentro en el modo en que se desarrolló esta relación en la Comarca Lagunera del centro-norte de México, una región emblemática de la reforma agraria cardenista en los años 30. A partir de documentación primaria, revistas técnicas, diarios y fuentes secundarias, sostengo que el actor principal en esta historia, el agrónomo e ingeniero hidráulico y Secretario de Agricultura Marte R. Gómez, personifica las contradicciones entre los avances en el entendimiento científico de la hidrología de México y los negocios y el desarrollo agrícola. Finalmente, propongo que estas contradicciones se encontraban en el corazón mismo de la reforma agraria y en su falta de sustentabilidad, tanto ecológica a largo plazo, como social y económica.
In the last two decades, Mexican water history, long considered a subfield of agrarian history, has become its own recognized field. This is due in large part to the founding of the Archivo Histórico del Agua (Historical Water Archive) in 1994, which made thousands of documents from federal water agencies available to researchers. As a result, a growing corpus of scholarly literature has emerged focusing on how and why Mexico underwent a technological revolution in water use and management, one that was an integral component of the country’s seventy-five year experiment in agrarian reform (1917–1992). ¹ In addition to the distribution of half of the country’s arable land to some 30,000 *ejidos* (state communal land grants) and small landholders, the Mexican postrevolutionary state constructed hundreds of large dams and vastly increased groundwater-pumping capacity. In line with world trends, from 1910 to 1993 water stored in dam reservoirs in Mexico increased from under one billion cubic meters to 143 billion cubic meters, while groundwater pumping increased from a negligible portion to 37 percent of total water use. ² Although Mexico is now a primarily urban and industrial country, its agricultural sector still consumes the vast majority (77 percent) of both surface and subsurface water resources. ³

In 1992, when Carlos Salinas de Gortari announced the revision of Article 27 of the 1917 Constitution that effectively terminated agrarian reform by ceasing new land distribution, he proudly referenced this technological revolution in water use and management. He declared that it had put Mexico among the top five countries in irrigated land area and praised the 15,000 técnicos (engineers, agronomists, topographers, and land surveyors) employed in different government agencies for their painstaking work on the revision. At the same time, he also highlighted the numerous environmental consequences that poor agricultural practices had wrought for decades: deforestation, soil erosion, contamination of waterways, and the depletion of aquifers, among others. ⁴ Yet Salinas—reflecting the voluminous scholarship on Mexican agrarian reform, including his own important contribution ⁵—seemed to be largely unaware or unconcerned that the application of these very same technologies he praised had in fact facilitated many of the unsustainable agricultural practices he decried.
In this paper, I examine the little explored historical relationship within the above-cited literature between advances in “eco-technical” knowledge of Mexico’s scarce and fragile water resources and the developmental imperatives of agrarian reform from the 1920s to the 1960s. By eco-technical knowledge, I mean the process by which hydraulic engineers, agronomists, and geohydrologists acquired their understanding and knowledge of nature’s workings through field observation, surveying, experimentation and testing to better exploit nature for developmental purposes. In particular I focus on how this relationship played out in the “Laguna” region of north-central Mexico. The Laguna, short for the Comarca Lagunera of southwestern Coahuila and northeastern Durango, was the emblematic region of Cardenista agrarian reform. There, in the fall of 1936, Lázaro Cárdenas decreed, and for three weeks even personally supervised, the expropriation of 226 cotton and wheat haciendas to create nearly 300 collective ejidos—the largest concentration in a single area of the country. The semiarid Laguna was Mexico’s preeminent cotton-growing region from the late nineteenth century. The torrential flows of the Nazas and Aguanaval rivers and the aquifers they recharged made the Laguna’s soil among the most fertile in the country—provided that farmers could secure sufficient water from the rivers and, from the 1920s, increasingly via groundwater pumping in order to irrigate their lands.

After reviewing the technological revolution in groundwater pumping and the planning and building of a high dam on the Nazas in the 1920s and 1930s and how integral both were to the 1936 Cardenista agrarian reform in the Laguna, I introduce a key actor in this history, Marte R. Gómez. Gómez earned the degree of ingeniero agrónomo y hidráulico (hydraulic agronomist engineer) at the National School of Agriculture in 1917. During the Revolution he styled himself a Zapatista after traveling to Morelos and Yucatán to survey land for distribution. He went on after the Revolution to serve in such important posts as Secretary of Agriculture (1928–30), Secretary of the Treasury (1933–34), governor of his home state of Tamaulipas (1937–1940), and again Secretary of Agriculture under Ávila Camacho (1940–1946). During his second term as Secretary of Agriculture, Gómez was instrumental in introducing the “Green Revolution”—as it was later termed in 1968—to Mexico as well as revising
Article 27 of the 1917 Constitution in 1945 to make groundwater subject to federal regulation. Initially sponsored by the Rockefeller Foundation, the Green Revolution was the brainchild of the late Norman Borlaug, a Nobel Prize–winning plant pathologist and geneticist who developed high-yield, disease-resistant corn and wheat varieties in Mexico. Mexico in turn served as the demonstration site for other developing countries in Latin America, South Asia, and Africa where the Green Revolution rapidly spread. The agricultural production techniques needed to grow these varieties required huge amounts of water, chemical fertilizers and pesticides, and fossil fuel powered machinery. In 1946 when his term ended, Gómez left politics and used his many connections to become the president of the Mexican subsidiary of the US-based multinational Worthington Pump and Machinery Corporation. He thereby facilitated the massive exploitation of fragile and limited groundwater sources needed for higher-yielding agriculture.

Drawing on primary documentation from the Archivo Histórico del Agua (AHA), technical journals, newspapers, and secondary sources, I argue in this paper that Gómez epitomized the contradictions between advances in scientific understanding of Mexico’s geohydrology, agricultural development, and business during his career both in and out of the government. I shall further contend that these contradictions—indeed, at times conflicts of interest, if not corruption—were at the heart of Mexican agrarian reform. Yet the substantial literature on political técnicos, corruption, and the Americanization of the Mexican economy has largely understudied this factor in explaining how and why the reform became ecologically as well as socially, economically, and politically unsustainable by the 1960s. This paper places this contradiction front and center. It was a contradiction inherent, as we shall see, in Article 27 of the 1917 Constitution and in techno-political actors like Gómez who served as intermediaries among the Mexican state, society, and nature.
**Modern Laguna Watershed Map.** This map displays the major cities of Lerdo, Gómez Palacio, and Torreón, the Nazas and Aguanaval rivers, and the two major storage dams—the Lázaro Cárdenas/El Palmito Dam in the northwest at the origin point of the Nazas and the Francisco Zarco near Lerdo—on the Nazas. The desiccated lagoons of Mayrán and Viesca into which the Nazas and Aguanaval once flowed regularly are also shown. Source: “Hydroclimatic Variability of the Upper Nazas Basin: Water Management Implications for the Irrigated area of the Comarca Lagunera, Mexico,” *Dendrochronologia* 22 (2005).

**CONTROVERSIAL DAM, UNCONTROVERSIAL PUMPS**

When the Mexican Revolution initially triumphed in 1911 under Francisco Madero’s leadership, the cotton-rich Laguna and its principal city of Torreón, a central rail hub of northern Mexico created in the 1880s, had long been a model of Porfirian agro-industrial development. Madero was a Lagunero, or native of the Laguna region, who hailed from San Pedro de las Colonias near the terminus of the Nazas River where it once drained inland into the Laguna de Mayrán (see map above). In 1907, just as he
was launching his political career, Madero published a small book advocating the building of a large dam on the Nazas in order to better control its torrential flows, reduce damage from unpredictable flooding and drought, and thereby vastly increase agricultural production. Drawing on the studies of federal engineers in the 1890s and his own agronomic training for his proposal, he asked Laguna agriculturalists to place their faith in an untested technology that would revolutionize their use of Nazas water. This proposed revolution, however, met with apathy, indifference and even hostility from most large landowners in the region, as Madero lamented in his study. He was unable to succeed in assuaging their fears of the dam’s potentially adverse impact on the river’s fertilizing flows, their water rights, and their pocketbooks (assuming as they did that they would foot the bill).  

Nevertheless, Porfirio Díaz strongly approved of Madero’s proposed project and hired the prestigious British engineering firm Pearson and Son to assess its feasibility. The demise of his regime and the onset of the Revolution indefinitely suspended it, however.  

Years after the end of the Revolution, in 1926 a coalition of federal engineers, a minority of landowners, the governors of Durango and Coahuila, and the mayors of Torreón and the Laguna’s other cities revived the project. In that same year the federal government under President Plutarco Elías Calles’s leadership founded the National Irrigation Commission (CNI). The CNI was modeled on the US Bureau of Reclamation to spur irrigation and colonization of unused arid lands. Since American and European technical know-how and technology still dominated the design and construction of most hydraulic engineering projects, the nationalist postrevolutionary state strove to “Mexicanize” them by hiring American engineers to train and tutor their Mexican counterparts.

With the advent of agrarian reform as a constitutionally mandated policy that could be implemented at any time, coupled with agraristas (agrarian activists) demanding land expropriations to form ejidos, most Laguna landowners—about 90 percent according to one of Torreón’s two newspapers—vehemently opposed the dam that the new CNI would plan and build. These landowners regarded the dam as the technological facilitator of a potentially radical agrarian reform. That is, by more equitably distributing river water among more water users, they feared that the
government would abrogate the water rights they had acquired prior to the Revolution. These had allowed some of the largest and most powerful landowners, such as the British-American Tlahualilo Cotton Estate, to consume or waste far more water than they needed. Moreover, many landowners also feared that damming the Nazas would impede the flow of rich fertilizing sediments that they captured and diverted onto their lands through flood irrigation methods.¹⁴

While the dam engendered much heated controversy and divided Laguna agriculturalists, the introduction of new groundwater pumps powered by internal combustion engines, electricity, or a combination thereof was comparatively uncontroversial. The difference lay in the individual nature of groundwater pumps, the social and environmental costs of which were far less visible and thus less feared. Each landowner could purchase and install a pump-powered well on his or her own property with few legal constraints, the only major obstacle being financial cost. By contrast, building the dam necessarily entailed a major federal role in its planning and construction and would impact the flow of a river essential to all water users. As such, the dam’s potential social, economic and environmental costs were far more visible and better understood than the gradual depletion of the underground aquifer.

Landowners therefore enthusiastically welcomed the revolution in groundwater pumping. According to the newspapers, memoirs, journals, private correspondence, and reports they produced, agriculturalists’ expectation was that a major expansion of groundwater pumping capacity would reduce their reliance on irregular river flow for their irrigation needs. As such, by increasing flexibility in irrigation, pumping would also reduce exposure of the cotton plant to the devastating pinkworm blight accidentally introduced to the Americas from Egypt in the 1910s. The blight could ruin up to 35 percent of the cotton crop in any given year.¹⁵

The *Siglo de Torreón* daily’s full transcription of a certain Dr. Juan Castillon’s presentation to the Rotary Club of Torreón in the summer of 1923 provides an example of the euphoria and pump-as-savior fervor that became pervasive in the region for decades. In his presentation Castillon described the Laguna as sitting on a “subterranean lake the dimensions of which I cannot calculate.”¹⁶ He called it a matter of “providence” that the flooding of the Nazas River’s torrential flows would
eventually filter down into the aquifer to the depth of 150 meters. The summer river flows helped “maintain this subterranean lake, always supplied with water,” thereby enabling “abundant harvests.” But this was nothing compared with what agriculturalists could expect if they “knew how to use natural resources.” The first well drilled for agricultural use in the Laguna, he noted, was in 1893. The well was still in use in the 1920s but able to water three times as much land area with the addition of a motor-powered pump. Every day more and more wells, he remarked enthusiastically, were being drilled and constructed along with the installation of power plants supplying the energy to run them.

The cost of well drilling was variable, Castillon explained, and depended on subsoil conditions. Water could be tapped at 12, 37, or more meters in depth. Once tapped, however, wells could last indefinitely, since “not a single well has run out of water to the point of becoming unproductive.” As of August 1923 when Castillon spoke, 80 wells were pumping out 6,000 liters of water per second from the aquifer, and by the end of the year he anticipated that 20 more would be drilled. “The development of this new industry—that is, pump irrigation here—has increased greatly and there is a veritable fever to drill more wells.” He boldly predicted that such wells “will affirm the wealth of the region” by pumping 7,500 liters of water per second. Looking ahead to 1924, he foresaw 100 more wells increasing the total volume to 15,000 liters per second after 300 days of pumping, equivalent to 366,000 cubic meters of water—exceeding the entire volume of the Nazas flow of 293,000 cubic meters in 1910. In economic terms, he concluded, an investment of 12.5 million pesos to finance 500 wells would increase agricultural production by 18 million pesos over what could be earned using river-based irrigation only. Although Castillon’s predictions about the increase and economic profitability of groundwater pumping were largely accurate, they would prove to be far too optimistic with regard to its ecological impact on the regional aquifer, as we shall see later.

At the time of Castillo’s speech, a number of American and European companies sought to enter this booming market in the groundwater pumps that were revolutionizing the Laguna’s—and much of Mexico’s—irrigated agriculture. Two that stood out in engineering and newspaper reports and advertisements were the Texas-
based Layne and Bowler Pump Company and the New York–based Worthington Pump and Machinery Corporation. Layne and Bowler, as will be detailed further below, was mentioned in an important federal engineers’ investigative report, while Worthington appeared in far more newspaper stories and advertisements. The latter was the namesake of the American engineer-inventor Henry R. Worthington, about which one historian of the vertical turbine pump industry remarked, “Certainly if there was one only proper name that meant pumps, it would be Worthington.” Indeed, his invention of the “single direct-acting steam pump” dramatically reduced the manual labor of steam-powered boats in 1840 and launched his career as a wildly successful entrepreneur. For forty years, he improved, expanded, and diversified his inventions and therefore product lines, including to such customers as the US Navy and various US municipal water works. In 1876 at least eighty major Worthington water works pumping engines had been installed in different parts of the US and Canada, with capacities ranging from half a million to fifteen million gallons daily. From 1883 Worthington began to aggressively seek foreign business. Less than a decade later, in 1893, Worthington’s markets had expanded outside of the US and Canada and its total estimated pumping capacity then in use was nearly three billion gallons in twenty-four hours. Among these foreign markets was Mexico, where the first sale of record was made in 1886. By 1940 Worthington was present in Europe, Asia, Africa, Oceania, and the Americas—specifically, in nineteen countries of Latin America and the Caribbean. Mexico was one of only two Latin American countries (the other Brazil) with two Worthington offices, one in Mexico City and the other in Monterrey.

In a September 1925 full-page advertisement in the El Siglo de Torreón, Worthington showcased two haciendas that had installed their engines and pumps, replete with illustrations and photographs. One included a photograph of the Las Vegas Hacienda station with the caption explaining how three diesel engines connected to an electric generator produced 200 horsepower. The other featured a picture of the Bohemia Hacienda’s irrigation canal being filled with water coming out of a discharge tube installed in the wells. This combination of Worthington diesel engines and coniflo pumps, the advertisement claimed, was especially designed to serve the irrigation needs of cotton and wheat planting. The results obtained, they further claimed, were
incomparable to any other installation in the Laguna. Moreover, both the diesel motors and the pumps were of extremely simple construction but worked as powerfully and safely as steam engines—the repair and maintenance of which could be entrusted to any competent mechanic without any special knowledge of them.²⁰

Worthington’s successful expansion into Latin America as the demand for groundwater pumping dramatically increased was driven by the invention of two pumps—the aforementioned Coniflo and the Axiflo—that resolved the challenge of elevating groundwater to the surface. The Axiflo pump was designed for wells with a diameter of 15 to 50 centimeters where water was found at a depth of no more than 60 meters from ground surface. Smaller Axiflo pumps could pump out water from a greater depth. The amount of water obtainable with Axiflo pumps varied from 380 to 22,700 liters per minute. The Coniflo pump was primarily designed to serve wells of 120 meters depth with the capacity to pump out 750 to 13,250 liters per minute. The ingeniousness of Coniflo pumps was their flexible design. In a successful installation in a Cuban sugar mill, an electric motor was mounted on the upper part of the pump’s external mechanism in order to power it. But the pump could run from power generated from diesel or gas engines or steam machines through a transmission line when an electric current was unavailable.²¹ The instruction manual for these two kinds of Worthington pumps forthrightly admonished, “the deep well pump must not run without an adequate supply of water.”²²

In 1928 Calles dispatched a commission of three prominent engineers to investigate the social and economic conditions of the Laguna in order to make recommendations for the implementation of a potential agrarian reform program. The engineers noted that landowners had connected internal combustion motors to their pumps by installing the former above ground. The discharge tubes for these wells averaged 8 to 10 inches in diameter and enabled the pumps to descend to a depth of 10 to 20 meters. In order to increase the flow of water to wells agriculturalists sunk the longer tubes that penetrated the water table some 60 meters below ground. While Worthington heavily advertised in the Siglo de Torreón, according to these engineers Laguna agriculturalists most commonly used the American company Layne and Bowler’s system of wells. The system consisted of drilling a hole of about 108
centimeters in diameter and then penetrating various layers of sand in a rotary fashion until the drill reached the water table. Through an intricate technique of placing narrow longer tubes within thicker shorter tubes that could descend further underground a motor wheel could then be installed to pump the water from the aquifer through these tubes. These types of Layne and Bowler pumps could extract 80 to 120 liters of water per second.\textsuperscript{23}

The cost of purchasing the pumps, tubes, and motors as well as the installation could be prohibitive for all but the wealthiest haciendas, however. Each unit with a motor varied between 20,000 and 40,000 pesos, but drilling several wells in the same lot and installing a central electric plant could substantially reduce the cost per unit. As competition for well drilling increased among several companies, a well could be purchased for between 8,000 and 10,000 pesos excluding the motor. Motors were of 75 to 80 horsepower for extracting water. Once installed, a well could irrigate up to 100 hectares at a cost of 2,000 pesos. The pumps lasted between eight and ten years, ample time to pay off a loan with interest while productivity greatly increased, provided that the machinery was well maintained. The engineers observed that the most efficient means of using the wells was to drill several of them on the same lot and to combine the water obtained from them with surface water conducted through special canals. If one well could produce 100 liters of water per second to fill a one square kilometer lot of land 22 centimeters high in forty days, five wells producing 500 liters per second could irrigate five lots in thirty days. In contrast to Worthington’s advertisements highlighting the flexible power source for their pumps, the engineers noted that the proliferation of such Layne and Bowler wells required using electric rather than motor pumps. To that end, another American company had planned to establish a grand central electric plant with a capacity of 50,000 to 70,000 horsepower to provide a sufficient and economical supply of electricity. The principal obstacle to the power plant, in the minds of Laguna agriculturalists, was the lack of sufficient guarantees owing to the indefinite status of agrarian reform in the region.\textsuperscript{24}

Overall, the well option enabled a reduction in the reliance on surface irrigation from fickle river flow that ensured better harvests, more regular annual crop yields and calming of social tensions by stabilizing employment for thousands of rural workers.\textsuperscript{25}
While the wells did not turn out to be the panacea that water-hungry agriculturalists had hoped, they did become an important supplementary source of irrigation water for small cotton plants during the scorching summer months. They also increased flexibility for planting times to mitigate losses caused by the aforementioned pinkworm blight. On the Las Vegas hacienda featured in the aforementioned Worthington advertisement, before the installation of wells in 1920, a maximum of 150 hectares could be cultivated; from 1920 to 1924 six wells were drilled augmenting the irrigable land area to nearly 880 hectares. By 1925 pump-powered wells had partially liberated growers from near exclusive reliance on cotton and considerably augmented wheat production during the cotton off-season.

With the onset of the Great Depression, Calles in 1930 declared an end to land distribution, but not before he faced the vehement protests of federal agronomists and agraristas who pressured him to reverse his decision. In the Laguna agrarian reform managed to stay on the agenda in spite of the constant efforts of large landowners to exempt the region from it. As always, water was the key to any possible change in land tenure. In 1932 the number of wells mushroomed to 365, which CNI geologists began to notice. The leading CNI geologist was the Austrian Paul Waitz, a geochemist by training hired by Porfirio Díaz’s Instituto Nacional de Geología shortly before the Revolution. Waitz remained to become one of Mexico’s leading figures in the burgeoning field of geohydrology in the 1920s and 1930s. The hydraulic engineer and historian José P. Arreguín Mañón defines geohydrology as “the study of the presence, distribution, movement, quality and rational use of subterranean water.” He demarcates 1935 as a turning point in Mexican geohydrology for two reasons. First, Charles V. Theis of the US Geological Survey formulated the first transient solution for groundwater flow toward a well by understanding the vital analogy between groundwater flow and heat transfer. The Theis transient pump test solution then became the standard for geohydrologists globally for well test interpretation. Second, that year also coincided with the first massive development of wells, especially in Mexico City and in other agricultural regions such as the Hermosillo coast in Sonora.

In this context Waitz published numerous studies on Mexico’s groundwater resources in the CNI’s new quarterly journal *Irrigación en México* that described how
to detect, measure, and extract them. Regarding the Laguna in 1930, he observed that groundwater exploitation with “pumps of a great diameter” had increased to such an extent that “great quantities of water” were being extracted at “very deep levels” from the infiltration of Nazas River flow deposits into the alluvial plain.31 Underlying his studies was a sense of caution about the potential consequences of profligate exploitation of groundwater from fragile aquifers. Fellow geologist and Waitz student Gonzalo Vivar made this sentiment explicit in a 1934 study on the Laguna:

It is desirable that in the case of drilling in the plain in search of water under pressure there exist adequate regulations on behalf of all. So far a true anarchy reigns with regard to the exploitation of groundwater: There is no technical direction in the distribution of drillings, or in the extraction of water from each drilling.32

At the time Vivar recommended that the Agricultural Chamber of the Laguna, consisting of powerful agriculturalists, regulate drilling. This proved fruitless, as landowners jealously guarded their precious water resources and were loath to cooperate with one another or the federal government for fear that their lands would be expropriated.33 In the meantime, the Siglo continued to run ads for Worthington pumps, one of them by a distributor named Engineer W. S. Hessel. Hessel’s slogan was “The Great Pump for the Laguna,” symbolized by the Worthington trademark eagle.34 By October 1, 1936, just five days before Cárdenas decreed the Laguna’s historic agrarian reform, Hessel had formed his own company, “Técnica del Norte,” with two other partners and had become a Worthington distributor in Torreón.35

THE DILEMMA OF PUMPING FOR CARDENISTA AGRARIAN REFORM IN THE LAGUNA

President Lázaro Cárdenas’s October 6, 1936, decree for the Laguna was a landmark event in the history of Mexican and Latin American agrarian reform. Pressured by a general strike of over a hundred urban and rural unions the previous summer that brought the regional economy to a standstill, Cárdenas promised a resolution to the problem in exchange for the strike’s termination.36 In less than two months after the decree, he delivered by distributing more than 200,000 hectares (494,000 acres) of
irrigable land to a total of nearly 40,000 heads of families. The hydraulic technologies that Cárdenas perceived as the reforms’ technological lynchpins were as important as the social and political events and processes driving this grand social experiment: a monumental dam to be built on the Nazas River and pump-powered wells. Landowners, who had long opposed the construction of the dam, had resigned themselves to it as well as to the expropriation of their lands, which they saw as complementary. After all, in the semiarid Laguna secure water was more important than the quantity of land, since it largely determined the quality of the land. Expropriated landowners thus accepted much reduced land areas in exchange for keeping their valuable hydraulic infrastructure, especially wells and pumps.

The correspondence of hydraulic engineers as Cárdenas assigned them the task of synchronizing the reparto de tierras (land distribution) with the reparto de aguas (water distribution) reveal much concern and even an air of panic. While the dam was heralded as the ultimate solution to the Laguna’s water problems, it would not be built for years. In the meantime, there simply were not sufficient water resources to irrigate all of the distributed lands to ejidos and small landholders alike. Groundwater access was thus key.

Nevertheless, engineers articulated a conundrum regarding such access. On November 16, 1936, while Cárdenas was still in the Laguna expediting land petitions to ejidos, CNI engineers charged with devising new water regulations noted in a memo to him that the excessive drilling of new wells should be impeded, and well drilling regulated in general. Overpumping, they noted, was drawing down the regional aquifer and thereby diminishing the irrigated area to the possible detriment of ejidos.37

Indeed, over eighteen months after the reparto de tierras, the engineer Francisco Allen proffered his opinion on the proliferation of pump-powered wells in a review of the progress of the reparto de aguas after attending meetings with the Coahuila Governor Rodriguez Triana and CNI executive Gabino Vázquez in June 1938. He wrote that wells should be merely a supplementary source of water for irrigating wheat and cotton fields—the primary source remaining the Nazas and Aguanaval river flows. He noted “every day [extracting water from wells] becomes more random and costly.”38 As an illustration of its effects, pumping had become so
intense that it had begun to harm the urban dwellers of Lerdo City in the Durango portion of the Laguna. With no potable water services, houses supplied with wells saw them dry up and were left with no domestic water source for several months of the year.\textsuperscript{39} Overall, in spite of repeated warnings from engineers throughout the 1930s, well drilling continued unabated as the construction of the Nazas River Dam dragged on into the 1940s. Estimates of the total number of wells by 1938 were between 900 and 1,000, a tenfold increase over 1926, when there were around 100.\textsuperscript{40} In spite of this growing concern, the most that the CNI did about unregulated drilling, pumping, and extractions during Cárdenas’s term was to undertake preliminary surveys of wells in use and estimate how much water was being withdrawn from the principal aquifer—without reliable knowledge of the precise volume of water it contained. As we will see below, there did not yet exist a regulatory legal framework for controlling groundwater extraction, which had not been explicitly incorporated into the 1917 Constitution, its regulations, and the Agrarian and Civil Codes of 1934.

**MARTE R. GÓMEZ AND POST-CARDENISTA AGRARIAN REFORM**

By the start of Gómez’s tenure as Ávila Camacho’s Secretary of Agriculture in 1940, groups to the left and right of Cárdenas had already judged the Laguna reparto de tierras to be inadequate or a total failure that should never have been carried out.\textsuperscript{41} This was largely on account of the incomplete reparto de aguas that had generated much conflict between ejidos and small landholders. Each bitterly complained to the government that the other was depriving them of water to grow their crops. Gómez continued to publicly defend the Cardenista reforma agraria in the Laguna, however, and looked to the completion of the delayed Nazas Dam as the eventual solution to the problem of water distribution conflicts and insufficient sources. In the meantime, he saw continued limited drilling of new wells as a stopgap measure.

In spite of public proclamations that the dam would make enough water available to irrigate up to 300,000 hectares, Gómez acknowledged in private that at maximum the Laguna’s irrigation district would only yield 160,000 hectares, with 100,000 from the dam reservoir and 60,000 from wells. Moreover, in confidential field
notes he took on a trip to the Laguna in 1941, he remarked that the combination of unabated well drilling and the construction of the dam could disrupt the fragile hydrological cycle between river flow and aquifer recharge. In other words, the traditional flood irrigation method known as *aniego* (flood) diverted the nutrient-rich Nazas flow onto croplands in order to retain their moisture for sufficient time until climatic conditions were appropriate for planting cotton and wheat. Since croplands could not absorb all of the water, much of it would evaporate or seep underground.

Engineers, including Gómez, were of two minds about this irrigation method. On one hand, they deemed it to be wasteful, since so much water went unused. On the other hand, the water infiltrating back underground helped recharge the aquifer, thereby ensuring water was available for pumping. A more “rational use of water,” as Gómez referred to damming the Nazas in his notes, would “likely diminish” aquifer levels and therefore “limit” the use of its waters. Moreover, the deteriorating quality of well water, as the use of “open wells” had demonstrated, was a “limiting factor” in the use of groundwater. For instance, on occasion groundwater could become so saturated with salt that its use would “not only harm the soil” but become detrimental to the entire regional economy, since so much of the land “would have to be abandoned for good.” Lastly, echoing Cardenista engineers before him, he reiterated that groundwater pumping could not be a principal source for irrigation water, but only “supplementary.” Therefore he stressed that no irrigation zone should rely exclusively on groundwater.42

By 1941, however, as much as a third of the Laguna’s irrigated water relied exclusively on groundwater pumping. Gómez thus could only push for the intensification of more studies to determine how much water was being pumped and to classify by zone where irrigation should be used exclusively with surface water and where it should be a combination of the two. The CNI’s top engineers—Antonio Coria and the naturalized Mexican Andrew Weiss—estimated in internal correspondence that there were as many as 2,500 wells in the Laguna and although “no study has shown the feasibility of using wells… indicators show it is unfeasible. Some are drawing up salt water,” including prominent small property owners, such as Señor don Agustín Zarzosa, owner of the La Granja Ranch near the Noé train station in Gómez Palacio,
Durango. Even with various pumping plants, “his soil is gradually hardening from using salt water from his wells. This is common and can continue until the soil has to be abandoned. This matter of salt water from water pumps is of prime importance to the life of the land in this region.”\textsuperscript{43}

Pump sellers seized on the opportunity to expand their sales of pump equipment. In 1941, there were at least two dozen ads in the Siglo de Torreón for new and used Worthington pumps. There is also indirect, circumstantial evidence that Gómez himself was involved in this pump business while in the government. In September 1945 the organizational umbrella for the Laguna’s ejidos, the Collective Ejidal Societies, accused Gómez of being an associate of the company “Equipos Mecánicos” and forcing them to buy Worthington products. The company, which sold Worthington pumps and engines in Torreón, vehemently denied the charge in a letter to the newspaper. In doing so, they took the opportunity to advertise their products and their much lower prices.\textsuperscript{44} Only five years after leaving office, however, Gómez’s private activities made such charges appear to have some grounds. In a letter to Miguel Alemán in June 1950, Gómez called Equipos Mecánicos “our [Worthington de México’s] distributors.”\textsuperscript{45}

**THE INAUGURATION OF WORTHINGTON DE MÉXICO**

After his stint as Secretary of Agriculture under Camacho, Gómez left politics to concentrate on business in the late 1940s and 1950s, in particular the establishment of the Mexican subsidiary of the New York–based Worthington Pump and Machinery Corporation. On May 15, 1951, his efforts bore fruit: Miguel Alemán and an entourage of cabinet members and prominent Mexican and American business representatives gathered to inaugurate the newly installed Worthington de México factory in Mexico City. In addition to Gómez, its President, the Vice President of its US parent company in New York, Clarence E. Searle, was also present. Both gave eloquent speeches describing the importance of the occasion and what it augured for Mexico. Searle placed it in the larger context of the Cold War, of “free nations of the world” combating “the forces of totalitarianism,” making the “interdependence of our two
nations even more significant.” In particular, he praised the efforts of the Mexican government to augment food production for self-sufficiency. Searle announced that Worthington would play a vital role in Mexico’s agricultural expansion, given that its activities were primarily devoted to the production of turbine pumps for irrigation. This would only be a beginning, however, as he hoped Worthington would expand its operations to include other types of equipment required for industrial uses.46

In his speech Gómez framed the inauguration of the factory in nationalist terms. Citing a United Nations economic study on the need for Mexico to produce its own capital goods, from tractors to water pumps, he declared the founding of Worthington de México a “matter of economic independence.” He noted that its initial paid up capital of four million pesos was entirely Mexican and would eventually increase to ten million. He did not shy away from announcing the pivotal role that the government played in supplying this all-Mexican capital: making use of the Ley de Fomento de Industria de Transformación (Law to Promote Industry), the Treasury Ministry provided much of the financing and import permits, while the Federal District provided tax exemptions through title 30 of a 1949 decree on the subject. In addition, Nacional Financiera (the national development bank) floated “series B bonds” totaling some 25 percent of Worthington de México’s total paid up capital.47 For his part, Alemán described the process as a “combined effort between Mexican capital and American technical cooperation to satisfy a great need for the country.” It was an effort in line with the objectives of Import Substitution Industrialization (ISI) then prevailing in much of Latin America and the developing world.48

According to Gómez, Worthington de México was poised to meet those needs for a major expansion in irrigation capacity throughout the country. It would produce 70 to 75 units of “pumps of great power for deep wells” on a monthly basis and also repair such pumps of the world-renowned Worthington line. As we have seen, Worthington had a long history of doing business in Mexico by 1951. In his inaugural speech Gómez noted the favorable reviews its products had received from the Secretary of Agriculture and Livestock via the Agricultural and Ejidal Banks, as well as from the Ministry of Hydraulic Resources, Pemex, and the Federal Electricity Commission. In other words, Worthington de México as a subsidiary of this
multinational corporation could already count on a virtually guaranteed domestic market—and one that Gómez would ensure to keep in Worthington’s hands as competitors sought to enter the market.49 Seemingly anticipating criticisms of such a sheltered industry, Gómez asserted that it was private initiative that had made it possible to bring Worthington to Mexico and import its technical capacity.50 Speaking directly to the President, Gómez nevertheless conceded, “we recognize that without the tutelary existence of the State, without the sympathy and stimulus that it has provided us, Worthington of Mexico might never have been founded.”

Numerous Mexican and American companies with branches in Mexico seemed to concur with this open endorsement of ISI. National Iron and Steel Works, GE, Electric Industries of Mexico, Remington Rand (makers of office equipment), and Electric Material all filled newspaper pages with their congratulatory messages to Worthington after its inauguration.51 Mexican workers also came in for much praise from the Worthington Plant Engineer Henry Carney, a New York industrial engineer then residing in Mexico who had planned and directed the construction and installation of the Worthington de México pump manufacturing plant. Carney affirmed, “Mexican technicians and industrial workers now rank among the best in the world.”52 In the following weeks and months editorials were effusive in their praise for the new and most “modern plant” of its kind in the world. Although the plant was then employing only 70 Mexican workers, it was predicted that it would eventually be able to export machinery to other countries in Latin America.53

In spite of the generally euphoric coverage of the inauguration of 1951 and the indispensable role that Gómez played in its realization, he was also the target of criticism in some media, to which he replied defensively. At issue in particular was the charge that he benefited from his favorable connections as ex-Agriculture Minister to obtain a contract for well drilling worth an astounding 60 million pesos.54 He vehemently denied these charges in a letter he wrote to the newspaper, which the latter subsequently published. He replied that “Agriculture has not given me any contract to drill wells: not for 60 pesos, not for 60 million pesos, but what I have received from the President—and without deserving it, since I didn’t lend any service to Alemanismo—are personal considerations, moral and economic support for the
organization of the pump factory for which I have dedicated all of my time and energy. From this standpoint, I recognize my indebtedness to President Miguel Alemán; I have said so openly when the occasion has permitted and I don’t find it inconvenient to reiterate it in writing.”

That the entry of Worthington under the auspices of the heretofore most corrupt Mexican president in the postrevolutionary era was clouded by the likelihood of shady deals and “crony capitalism” is perhaps unsurprising. What went almost entirely uncovered, however, were Mexico’s finite water sources, especially in light of one of the worst droughts in the nation’s history which had been affecting the most agriculturally productive northern regions since 1948. Indeed, the drought of the 1950s throughout North America including Mexico became known as the “mini-Dust Bowl.” It was a repeat on a smaller scale of the devastating Dust Bowl of the 1930s when soil, parched from decades of overgrazing and the plowing up of the prairies of the Great Plains, created huge wind-blown dust storms during a prolonged drought.

Mexico’s principal federal water management authority, the Secretaría de Recursos Hidráulicos (SRH) founded as the upgraded successor to the CNI in 1946, had already long noted the increasingly serious deterioration in the state of the country’s subterranean water supplies. Thirty years after the 1917 Constitution effectively placed nearly all surface water sources under national stewardship—and at least a decade after engineers started warning of the potentially adverse consequences of unregulated well-drilling and pumping—groundwater was finally incorporated into Article 27 in a 1945 revision under Gómez’s term as Agriculture Secretary. As the engineer René Carvajal of the SRH explained in a detailed study of groundwater legislation in 1967, Article 27 did not explicitly include groundwater sources as national property—only indirectly as part of subsoil minerals when these were mined. This was because of the lack of technical knowledge of groundwater sources at the time in Mexico and because of the scant need for intensive use of these sources.

Prior to the 1917 Constitution, the only reference to control of groundwater resources was in civil law from the 1884 Civil Code, subsequently incorporated into the Civil Code of 1932. Numerous articles of the Code granted individuals the right to drill wells or build diversion dams to capture water as they saw fit. However, if water
flowed from one property to another, its use was considered of “public utility” and subject to special regulations. Water users could not harm the interests of their neighbors, but they could use their water if they compensated them for that use. While the civil codes did not expressly regulate groundwater use or restrict it, the principle that the government, as the steward of public waters, could intervene to ensure its availability for all was firmly established.

In that vein, the 1934 Law of Waters of National Property distinguished between private and national waters. It permitted property owners to extract as much water as they needed from their lands so long as these did not include rivers or natural deposits regarded as national property. If national waters were affected, the Secretary in question, in this case Agriculture, could prevent the taking of water or the building of private works that could enable it. In other words, there existed an absolute individual liberty to extract water on private property, so long as this did not affect national waters. The 1945 revision to Article 27, and its subsequent regulations in 1947, changed this by explicitly including groundwater alongside surface water as subject to federal regulation. It thus eliminated the distinction between private and national waters in certain cases. While property owners were free to extract water on their lands, if such activity affected the “public interest” or existing uses, the SRH could regulate the use and extraction of groundwater and establish no-use zones as if private water were national property.

Consequently, the revision established a property owner’s obligation to inform the SRH when initiating works to extract groundwater, with the exception of wells for domestic use (as opposed to agricultural use). Most importantly, the 1947 regulations imposed a concrete restriction for the first time that was subject from then on to the knowledge provided by technical studies. If such studies of a zone or region and of the technologies to extract groundwater to its maximum limits determined that doing so was detrimental to the public interest or existing uses, the SRH could propose a prohibition on groundwater extraction to the president.59

The 1947 regulation went further by also stipulating penalties for violating the law and authorized the SRH to prevent the installation of works or technologies that could do so, even to the point of demolishing such works. Yet for all of the new
regulations and restrictions on groundwater use, the revision also charged the SRH with fomenting the use of groundwater for the purposes of rapidly increasing agricultural development for a growing population. These two simultaneous stipulations—fomenting and restricting—were clearly at cross-purposes. This became apparent as the SRH declared prohibitions on groundwater use on a yearly basis beginning in 1948 in nearly all of the central and northern areas of the country (see table below):
### TABLE 1

**PROHIBITIONS ON GROUNDWATER USE**

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abasolo, Guanajuato</td>
<td>December 22, 1949</td>
</tr>
<tr>
<td>Alvarado, Veracruz</td>
<td>February 3, 1951</td>
</tr>
<tr>
<td>Cadereyta, Queretaro</td>
<td>October 3, 1951</td>
</tr>
<tr>
<td>Cañada del Marqués, Queretaro</td>
<td>February 13, 1949</td>
</tr>
<tr>
<td>Ceballos, Durango</td>
<td>October 28, 1952</td>
</tr>
<tr>
<td>Chihuahua, Chihuahua</td>
<td>February 7, 1952</td>
</tr>
<tr>
<td>Comarca Lagunera, Durango and Coahuila</td>
<td>April 27, 1949</td>
</tr>
<tr>
<td>Costa de Hermosillo, Sonora</td>
<td>July 11, 1951</td>
</tr>
<tr>
<td>Costa de Hermosillo, Sonora (Expanded prohibition)</td>
<td>December 11, 1954</td>
</tr>
<tr>
<td>Costa de Hermosillo, Sonora</td>
<td>March 14, 1963</td>
</tr>
<tr>
<td>Cuenca del Rio Guayalejo, Tamaulipas</td>
<td>February 21, 1955</td>
</tr>
<tr>
<td>Distrito de Riego de El Carmen y Villa Ahumada, Chihuahua</td>
<td>January 30, 1957</td>
</tr>
<tr>
<td>Distrito de Riego del Rio Colorado, Baja California</td>
<td>December 16, 1955</td>
</tr>
<tr>
<td>Distrito de Riego del Rio Mayo, Sonora</td>
<td>February 21, 1956</td>
</tr>
<tr>
<td>Distrito de Riego del Rio Mocorito, Sinaloa</td>
<td>December 18, 1956</td>
</tr>
<tr>
<td>Distrito de Riego del Rio Yaqui, Sonora</td>
<td>October 14, 1954</td>
</tr>
<tr>
<td>Distrito de Riego Laguna de Tecocomulco, Hidalgo</td>
<td>January 26, 1957</td>
</tr>
<tr>
<td>Distrito Nacional de Riego of Baja California Sur</td>
<td>July 2, 1954</td>
</tr>
<tr>
<td>Distrito Nacional de Riego de Casas Grandes, Chihuahua</td>
<td>July 6, 1954</td>
</tr>
<tr>
<td>El Salitre, Michoacán</td>
<td>February 11, 1956</td>
</tr>
<tr>
<td>Laguna de los Azufres, Michoacán</td>
<td>February 13, 1956</td>
</tr>
<tr>
<td>Laguna de Tachac, Hidalgo</td>
<td>August 19, 1954</td>
</tr>
<tr>
<td>León, Guanajuato (Second Zone)</td>
<td>October 25, 1948</td>
</tr>
<tr>
<td>León, Guanajuato</td>
<td>October 25, 1948</td>
</tr>
<tr>
<td>Monterrey, Nuevo León</td>
<td>July 17, 1951</td>
</tr>
<tr>
<td>Monterrey, Nuevo León</td>
<td>December 14, 1956</td>
</tr>
<tr>
<td>Monterrey, Nuevo León</td>
<td>December 19, 1956</td>
</tr>
<tr>
<td>Location</td>
<td>Date</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Monterrey, Nuevo León</td>
<td>June 19, 1958</td>
</tr>
<tr>
<td>Ramos Arizpe, Coah. (Expanded prohibition)</td>
<td>March 10, 1951</td>
</tr>
<tr>
<td>Region de Jimenez, Chihuahua</td>
<td>July 12, 1951</td>
</tr>
<tr>
<td>Región de Tecocomulco, Hidalgo</td>
<td>August 19, 1954</td>
</tr>
<tr>
<td>Región Meridional del Teritorio Sur de la Baja California</td>
<td>July 6, 1954</td>
</tr>
<tr>
<td>Saltillo, Coahuila</td>
<td>February 7, 1952</td>
</tr>
<tr>
<td>San Miguel de Allende, Guanajuato</td>
<td>January 24, 1949</td>
</tr>
<tr>
<td>Silao, Irapuato y Salamanca, Guanajuato</td>
<td>June 5, 1957</td>
</tr>
<tr>
<td>Tecozauntla, Hidalgo</td>
<td>February 11, 1956</td>
</tr>
<tr>
<td>Tehuacán, Puebla.</td>
<td>June 28, 1950</td>
</tr>
<tr>
<td>Tehuacán, Puebla (Expanded Prohibition)</td>
<td>March 2, 1959</td>
</tr>
<tr>
<td>Tequisquiac, Queretaro</td>
<td>October 27, 1950</td>
</tr>
<tr>
<td>Tequisquiapán, Queretaro</td>
<td>December 3, 1960</td>
</tr>
<tr>
<td>Tijuana Basin, Baja California</td>
<td>November 13, 1956</td>
</tr>
<tr>
<td>Valle de Guadiana, Durango</td>
<td>December 19, 1956</td>
</tr>
<tr>
<td>Valle de Guaymas, Sonora</td>
<td>December 20, 1956</td>
</tr>
<tr>
<td>Valle de Juarez, Chihuahua</td>
<td>March 18, 1952</td>
</tr>
<tr>
<td>Valle de México, DF, and Mexico and Hidalgo states</td>
<td>August 19, 1954</td>
</tr>
<tr>
<td>Valle Santo Domingo, Baja California Sur</td>
<td>October 8, 1951</td>
</tr>
<tr>
<td>Villa Aldama, Chihuahua</td>
<td>December 31, 1953</td>
</tr>
<tr>
<td>Zona de Celaya, Guanajuato (Región del Bajio)</td>
<td>October 29, 1952</td>
</tr>
<tr>
<td>Zona de Cieneguillas, Sonora</td>
<td>December 19, 1956</td>
</tr>
<tr>
<td>Zona de Riego del Rio Fuerte, Sinora</td>
<td>August 25, 1956</td>
</tr>
<tr>
<td>Zumpango, Mexico</td>
<td>December 22, 1949</td>
</tr>
</tbody>
</table>


As these *vedas*, or prohibitions or moratoriums on groundwater pumping, show, the SRH, at least on paper, tried to exercise its regulatory powers. As the technical studies it undertook indicated alarming levels of depletion and contamination via salinization, the SRH established fifty *vedas* from 1948 to 1963, three of them in the Laguna in
1949, 1952, and 1958. In 1958, the SRH established three kinds of *vedas*: 1) prohibited zones where it is not possible to increase extractions without the danger of dangerously depleting water tables; 2) zones where the capacity of aquifers can only permit extractions for domestic use; 3) zones where the capacity permits limited extractions for domestic, industrial, irrigation, and other uses.

The *vedas* in the Laguna, as elsewhere in Mexico, were rarely enforced. There were two principal reasons for this. One was that the SRH simply did not monitor groundwater withdrawals from individual wells, which was a difficult task as their number increased to over 3,000 by 1958 (see the following table).

<table>
<thead>
<tr>
<th>TABLE 2: DISTRIBUTION AND TYPE OF 3,087 WELLS IN LAGUNA: PROHIBITED AND NONPROHIBITED ZONES BETWEEN EJIDOS AND SMALL LANDHOLDERS, 1958</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prohibited Zone – small landholders</strong></td>
</tr>
<tr>
<td>Durango</td>
</tr>
<tr>
<td>472</td>
</tr>
<tr>
<td><strong>Prohibited Zone – ejidos</strong></td>
</tr>
<tr>
<td>Durango</td>
</tr>
<tr>
<td>310</td>
</tr>
<tr>
<td><strong>Nonprohibited Zone – small landholders</strong></td>
</tr>
<tr>
<td>Durango</td>
</tr>
<tr>
<td>158</td>
</tr>
<tr>
<td><strong>Nonprohibited Zone – ejidos</strong></td>
</tr>
<tr>
<td>Durango</td>
</tr>
<tr>
<td>552</td>
</tr>
<tr>
<td><strong>Motor pump-powered wells</strong></td>
</tr>
<tr>
<td>Durango</td>
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<tr>
<td>402</td>
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<tr>
<td><strong>Electric pump-powered wells</strong></td>
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<tr>
<td>Durango</td>
</tr>
<tr>
<td>1,092</td>
</tr>
<tr>
<td><strong>State totals</strong></td>
</tr>
<tr>
<td>Durango</td>
</tr>
<tr>
<td>1,492</td>
</tr>
</tbody>
</table>

Source: *El Siglo de Torreón*.

A second reason is that agriculturalists were divided in their reactions to the *vedas*. Some, like the conservation group “Amigos del Suelo” (Friends of the Soil) and the Agricultural Association of Durango, petitioned vigorously for the enforcement of the *vedas*. The association blamed lack of knowledge of the law, economic conditions, and negligence among its members for noncompliance with the *veda*. While the
association’s primary concern was economic, Amigos del Suelo articulated an explicitly ecological concern regarding the Laguna’s alarming groundwater situation, anticipating the concept of sustainable development made popular worldwide in the 1980s by the Brundtland Report of the United Nations. Founded in 1949 and inspired by the landmark 1946 law on soil and water conservation, in 1957 Amigos del Suelo released to the local press a plea for respect for the government’s vedas. “It’s an elemental principal of our Association to be vigilant that future generations receive the lands, waters, fauna and flora and all the natural resources in a satisfactory state of conservation, without present generations using them exclusively,” yet “at present natural resources are being exploited, without regard for the future, to the detriment of present and future generations,” they insisted.

Other agricultural associations, including many ejidos, petitioned for the temporary or complete lifting of the vedas, or that they not be expanded further without more careful studies. The reactions of different groups seemed to depend on their confidence in the SRH’s technical studies, the economic impact of drought conditions on them, and their geographical location within the region. Indeed, for some, drilling wells was literally a matter of survival and concerns for conservation were few or nonexistent. As the anthropologist Isabel Kelly of the Institute of Inter-American Affairs, the precursor to the US Agency for International Development (AID), noted in her fieldwork in the Laguna ejido of “El Cuije” near Torreón in 1953:

In the first place, it may be noted that the Cuije ejidatario tends to see all agricultural problems exclusively in terms of water shortage. That is to say, he is not conscious of deficiencies on other scores. For this reason, El Cuije deliberately has voted a formidable public indebtedness in order to sink new deep wells, secure in the conviction that these will mean the final solution to all its agricultural problems... At the moment, it should be pointed out that even the water problem itself is not viewed by the ejidatario in true perspective. He does not realize that subsurface water is being used at an alarming rate; that every new deep well which is sunk accelerates the consumption of such water and that, if the drought recurs and endures, so that subsurface water is not replenished, the day of reckoning cannot be far removed. Such lack of perspective with respect to local water supply could, in the course of the years, be literally fatal for the whole Laguna. It
would seem to apply, incidentally, not to the *ejidatario* alone, but perhaps in lesser degree, to the private landholder as well.\textsuperscript{67}

Gómez’s new Worthington de México was quick to capitalize on the demand for groundwater pumps and motors in the Laguna. Already in October 1948 while he was laying the foundations for its Mexican subsidiary, a Laguna-based Worthington distributor advertised “Mr. Agriculturist: The new high efficiency Worthington pumps have arrived. They can be regulated to extract the amount of water you desire up to a depth of 73 meters. Low prices.”\textsuperscript{68} Through the 1950s Worthington de México advertised heavily in the *Siglo de Torreón*, either directly or through the newly inaugurated machinery supply store “Equipos Mecánicos de La Laguna.” In 1956 Gómez attended the inauguration of the store along with a who’s who of government and business elites in agriculture and industry.\textsuperscript{69}

It was during the 1950s drought that groundwater pumping reached truly unsustainable levels in the Laguna, according to solemn warnings from engineers’ reports to public declarations by the SRH (see appendix B for graph of progressive aquifer depletion). In 1961, just as the region began to recover from the years of drought thanks to increased rainfall and greater agricultural productivity—the latter largely due to the use of hybrid seeds, chemical fertilizers and pesticides as part of the aforementioned “Green Revolution”—Worthington de México intensified its advertising. In one noteworthy instance, it titled an ad “An Inexhaustible Torrent of Water for Sowing your Fields with Worthington Pumps.” The ad featured an illustration of an agriculturalist standing beside his motorized pump as it pours a torrent of water like a giant spigot into his field (see advertisement below). The ad continued, “Rain or no rain, farmer friend, your crops are safe with a proper Worthington pump.”
This push for the installation of more and improved groundwater pumps coincided with the founding of a dairy industry in the Laguna as part of a local-state-federal effort to diversify the regional economy. Unlike the old white gold of cotton, which faced severe competition from foreign producers, synthetics, and other Mexican areas (Mexicalí, Lower Rio Bravo), there was ever increasing demand for the new white
gold of dairy in Mexico’s rapidly growing cities. Like cotton, however, dairy production—from the growing of cattle feed to the daily drinking needs of dairy cows—was highly water-intensive; in fact, it was far more water-intensive than cotton. Today it is estimated that 2,000 gallons of water are required to produce one gallon of milk from dairy cows.  

By 1959, however, the Laguna’s dairy industry was well on a steady growth path. In 1948 there were 4,000 heads of cattle producing 33,000 liters of milk per day. In 1962 there were 18,000 producing 175,000 liters per day (see Appendix C). This major expansion had its roots in 1949 and 1950, just as Gómez was working to found Worthington de México. In those years the governor of Coahuila worked to secure four million dollars in credit to form a union or cooperative of numerous dairy farms to purchase 10,000 calves. These calves would form the base for a future dairy industry that was to convert the Laguna into the “Wisconsin of Mexico.” Equally important was the establishment of a pasteurization plant in Torreón in 1950 to meet new health and hygiene standards for milk production in Mexico.  

In 1953 the Subsecretary of Livestock and Mexico’s representative for the Dutch dairy industry, an engineer, worked to further expand the Laguna’s dairy industry by establishing sterilization plants. While small landholders were the most enthusiastic about establishing this agro-industry on a large scale, the ejidatarios of the ejido Emiliano Zapata of Viesca were also in agreement with the initiative.  

There was much tragic irony that such an ejido from Viesca, located a little east of Torreón between the Nazas and Aguanaval Rivers, would look to the burgeoning dairy industry as a savior. According to engineers who investigated its underground springs that had been plentiful until the 1940s, from 1947 to 1953 overpumping and the regulation of the Aguanaval River in its upper portion completely extinguished the springs. As one engineer observed after surveying the devastation of Viesca’s springs that had prompted the abandonment of several pueblos and rural outmigration towards Mexico’s urban areas, “I especially want to emphasize that while small property owners have no limit on what they can exploit from wells to irrigate, using them as they do all year long, the ejidatario can only use a well in the summer to cultivate cotton, and with very limited credit.” In their desperation for a source of livelihood,
the advent of a dairy industry understandably appeared attractive to ejidos, even if it required even more profligate water use. In 1955 240 cattle were purchased from Canada at one thousand pesos per head for stables in Gómez Palacio, Durango, right across the Nazas riverbed from Torreón. This was heralded as the beginning of the end of cotton monoculture in the Laguna. It was also, however, the beginning of a new acuifundio— or large water monopolizer—that would morph into the “LALA” consortium of dairy producers by the 1970s, while the Laguna’s water table continued its relentless decline (see appendix B), two new vedaś (1965 and 1981) went unenforced, and naturally occurring arsenic began leeching into groundwater as drills penetrated ever more deeply underground (up to 180 meters in the 1970s).

CONCLUSION

In 1965 Worthington de México employed 215 people and had increased its capital threefold to 30 million pesos since its inauguration in 1951. One of the principal reasons for this success, Gómez explained, was the “enthusiastic collaboration of all administrative functionaries, technicians and workers who do not see Worthington de México as a foreign company—one that they only work for to get a salary—but rather as enthusiastically their own.” This explanation, however, did not tell the whole story, as we have seen. Political connections, conflicts of interest, and the inherent contradiction between advances in geohydrological knowledge and developmental imperatives were also contributing factors. These all worked together to turn agrarian reform as the overarching postrevolutionary developmental program in the Laguna and throughout Mexico into a veritable business for privileged actors.

Just four years before Gómez boasted of Worthington de México’s success, concerned urban residents of Torreón tried to call attention to the extreme hardship ejidos were experiencing after years of drought. They noted that fewer ejidos had access to groundwater pumps compared with small landholders. In a letter to the Siglo unnamed “humanitarian residents” referred to the “drought that has battered the Laguna” and made life in Torreón difficult. But “this is nothing compared with …
[our] poor campesino compatriots, the majority of whose wives are found daily in the streets begging for charity hoping to take back to their children just a little stale piece of bread or clothing with which to cover their humiliated little bodies.” In order to help alleviate the lot of pauperized ejidatarios, the letter-writers proposed to set up a “Pro-Nativity Committee” exclusively for them made of “altruistic persons” from the community as well as three members from the Ejidal Bank and three ejidatarios. Once formed, the committee would ensure that the President, state governors, agriculturalists (presumably referring to small landholders), businessmen, and others equitably distributed the funds raised among all the needy. ⁷⁹

The Laguna was only one of many regions to experience the adverse impact of overexploitation of its aquifers as early as the 1930s. Due to the exponential expansion in irrigation, potable water and sewage services, and industrial uses—along with the Worthington-supplied pump and drilling technology that enabled such development—32 of Mexico’s 653 aquifers had been overdrawn and contaminated by 1975. These increased to 104 in 2006 and accounted for 60 percent of Mexico’s overall groundwater supplies. ⁸⁰ In 2008 Felipe Calderón termed Mexico’s water crisis a matter of “national security.” ⁸¹

To say that hindsight is always 20/20 would beg the question of why technopolitical actors like Gómez did not act upon the knowledge and concern that they clearly possessed, even if the concept of “sustainable development” had not yet been formulated and (at least nominally) incorporated into national economic planning. The most compelling answer to the question, as this paper has documented, is a conflict of interest: in a position to regulate groundwater pumping, Gómez had a vested interest in a business and technology that profited from such pumping. Yet there are two caveats to such a seemingly obvious and straightforward explanation. The first is that he also knew that overpumping could undermine the viability of government programs and policies, especially agrarian reform, on which the legitimacy of the one-party state depended. And his pumping business also depended on that continuing legitimacy. Second, Gómez proudly viewed himself as a man of science; as he wrote his son in 1950, “Do not forget, above all, that science is a daily undertaking and those who fail to keep up with its progress, get rusty and fall behind and end up one among
Hydraulic science was unquestionably informing him that groundwater pumping was not sustainable at the rate at which it was extracting water from aquifers all over Mexico in the 1940s and 1950s. It is in this sense that José Luis Moreno Vázquez drew the following conclusion in his comprehensive study of the depletion and contamination of the Hermosillo coast aquifer of Sonora:

Unlike what I had thought when I began this research, the concern for the overexploitation of water exists only in words, not in reality. That is, there is consciousness of aquifer overexploitation and of the negative effects it causes, but no clear strategies or actions are devised to diminish it. The most efficient use of water that there is on a few properties is not for ecological but economic reasons: to increase profitability per cubic meter of water used. The remark often went, “it’s still an inexhaustible aquifer,” “water is to be used,” “with money and technology anything is possible,” “if the water runs out we’ll go elsewhere and do something else.”

Indeed, by the time such knowledge of environmental contamination was incontrovertible and overwhelming in the 1970s, the populist presidencies of Echeverría and Portillo took a strong stand on the global stage that development would come first, environmental protection second—if at all. As Mexico’s environmental degradation intensified and began to affect the quality of life of the urban middle and upper classes, however, the de la Madrid and Salinas presidencies passed much progressive environmental legislation in the 1980s and 1990s. Luis Aboites has termed this the transition from the “grand hydraulics” (1920s–1970s) to the “mercantile-environmental” (1980s to the present). With the founding of an Environmental Ministry (SEMARNAT) in 1992, under which the successor to the SRH, the National Water Commission (CNA), was housed, Mexico joined many other developing countries in officially incorporating sustainability into government planning. Unfortunately, the SEMARNAT is among the least powerful and effective of all the ministries, and its budget is comparatively low. Moreover, the kinds of conflicts of interest that existed prior to the official commitment to sustainable developmentalism documented in this paper persist into the present. A case in point is the LALA (short for “La Laguna” dairy group), the origins of which I discussed in this paper.
From the 1970s LALA became the principal agricultural water user of the Laguna by absorbing many private landholders into its consortium of cattle and alfalfa growers. These LALA-affiliated landholders own the most powerful groundwater pumps and are able to drill wells and pump water with abandon despite the passage of far stricter laws and regulations than existed even in the 1940s and 1950s. The CNA does not monitor LALA’s groundwater extractions yet strictly rations surface waters released from the Nazas Dam reservoir on which many ejidos rely.\(^\text{86}\)

In spite of much local protest by ejidatarios and concerned citizens against this social and environmental injustice, the first truly democratically elected Mexican president since Francisco Madero in 1911—Vicente Fox of the opposition PAN party in 2000—appointed the CEO of LALA to head the CNA in 2006.\(^\text{87}\) The CNA’s five-year plan for 2007–2012 publicly released in 2006 entailed the “adequate management and preservation of water, given its importance for social welfare, economic development, and the preservation of the ecological wealth of the country.”\(^\text{88}\) While more environmentally friendly, the phrasing of the CNA’s plan is little changed from that of the revised Article 27 of 1945 or the revision of 1992 that terminated agrarian reform, both of which stipulated two important objectives—development and conservation. These two have yet to be harmonized in Mexico and many areas of the world.
APPENDICES

APPENDIX A

ESTIMATE OF WELLS DRILLED AND IN USE IN LAGUNA 1920–1980

<table>
<thead>
<tr>
<th>Year</th>
<th>Wells Drilled</th>
<th>Wells in Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>1926</td>
<td>114</td>
<td>114</td>
</tr>
<tr>
<td>1932</td>
<td>365</td>
<td>365</td>
</tr>
<tr>
<td>1938</td>
<td>996</td>
<td>996</td>
</tr>
<tr>
<td>1944</td>
<td>1546</td>
<td>1546</td>
</tr>
<tr>
<td>1950</td>
<td>2014</td>
<td>2014</td>
</tr>
<tr>
<td>1956</td>
<td>2704</td>
<td>2704</td>
</tr>
<tr>
<td>1962</td>
<td>2947</td>
<td>2748</td>
</tr>
<tr>
<td>1968</td>
<td>3035</td>
<td>2554</td>
</tr>
<tr>
<td>1974</td>
<td>3088</td>
<td>2367</td>
</tr>
<tr>
<td>1980</td>
<td>3334</td>
<td>2467</td>
</tr>
</tbody>
</table>

## APPENDIX C

### MILK, CATTLE, AND COTTON PRODUCTION IN LAGUNA 1948–2004

<table>
<thead>
<tr>
<th>Year</th>
<th>Liters of Milk per Day</th>
<th>Cattle Heads</th>
<th>Area of Cotton in Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>33,000</td>
<td>4,000</td>
<td>80,100</td>
</tr>
<tr>
<td>1962</td>
<td>175,000</td>
<td>18,000</td>
<td>90,443</td>
</tr>
<tr>
<td>1967</td>
<td>220,000</td>
<td>35,000</td>
<td>84,217</td>
</tr>
<tr>
<td>1970</td>
<td>450,000</td>
<td>45,000</td>
<td>81,084</td>
</tr>
<tr>
<td>1977</td>
<td>1,087,671</td>
<td>90,000</td>
<td>72,236</td>
</tr>
<tr>
<td>1980</td>
<td>1,150,684</td>
<td>73,421</td>
<td>65,886</td>
</tr>
<tr>
<td>1988</td>
<td>1,290,410</td>
<td>109,000</td>
<td>66,490</td>
</tr>
<tr>
<td>1990</td>
<td>1,475,674</td>
<td>200,584</td>
<td>52,281</td>
</tr>
<tr>
<td>2000</td>
<td>4,461,281</td>
<td>415,596</td>
<td>8,284</td>
</tr>
<tr>
<td>2004</td>
<td>4,850,000</td>
<td>470,000</td>
<td>15,860</td>
</tr>
</tbody>
</table>

ENDNOTES


The following works discuss corruption, technocrats, and the Americanization of the Mexican economy but say little to nothing about eco-technical knowledge or environmental change in

10 Francisco I. Madero, *Estudio sobre la conveniencia de la construcción de una presa* (San Pedro, Coahuila, Mexico: Impreso en los Talleres de Tipografia Benito Juarez, 1907), 41–53.
13 *La Opinión* (Torreón), March 10, 1926.
16 Unless otherwise noted, all translations are the author’s.
19 Worthington Pump and Machinery Corporation, *100 years, 1840–1940, Worthington* (Harrison, NJ: 1940), 8, 14, 71, 75. Worthington was also a major supplier to the US oil companies in
Mexico, to which the Mexican national oil company Pemex turned for supplies as well after the 1938 nationalization of foreign oil companies. Worthington reluctantly refused on account of the boycott imposed by the US oil industry on Mexico in retaliation for the nationalization. As a newspaper report explained, “Recently a Mexican purchasing agent asked the Worthington Pump Company to sell $40,000 worth of spare parts for oil refining machinery, offering to pay cash. Worthington refused, explained it did $900,000 annual business with Standard and Sinclair (whose properties have been seized by Mexico) that these companies might boycott Worthington if it sold to the Mexican government. So Mexico bought from Germany.” “The Washington Merry-Go-Round,” *Spokane Daily Chronicle*, January 17, 1939.

24 Ibid., 197.


34 “La Gran Bomba para La Laguna,” *El Siglo de Torreón*, October 23, 1934, Classfieds section. There were also ads on Sept 27th and October 5th of that year.

35 He was also a distributor of other company products including Bombas Compresoras, Nartillos, Medidores de Agua, A.D. Cook, Inc., Bombas Verticales, Koerting Motores, and Siemens-Mexico, but apparently not Layne and Bowler.


37 AHA, AS, Box 347, File 7226, p. 16. November 16, 1936. This recommendation was incorporated into the December 15, 1936 presidential decree ordering the CNI to study and propose a regulation for well water usage and its legal basis. It would take years to happen and for federal laws to be passed to that effect in the late 1940s, about which more below.


40 Wolfe, “Water and Revolution,” Chapters 5 and 7. There are an estimated 3,000 wells today pumping water from the aquifers, with few if any measures on water consumption. See appendix A for historical statistics.

41 The most articulate critique on the left was from Liga de Agrónomos Socialistas, *El colectivismo agrario en México, La Comarca Lagunera* (Mexico: Industrial Gráfica, 1940), and on the right from Manuel Gómez Morin, interviewed in Wilkie, Monzón de Wilkie, and Beteta, *México visto en el siglo XX*, 75–139.

42 AHA, AS, Box 3067, File 42425, p. 38. Informe de La Laguna, April 12, 1941.

43 AHA, CT, Box 136, File 1121, p. 397. Informe de Distrito de Riego, Laguna, April 12, 1941.


46 *Novedades*, May 15th, 1951.


Gómez wrote to Alemán that he was seriously worried about the attitude that various foreign factories, especially Fairbank-Morse, were taking by offering up to 15 million pesos in credit to different Mexican agricultural credit banks to purchase just the kind of pumps he planned to manufacture. He appealed to Alemán, as well as to the ministries and banks in question, not to accept such offers until he could make Worthington’s case, namely, that it would help spur Mexican industrialization and be able to manufacture the same goods at better prices. AMRG, 1950 H-M, Gómez to Alemán, January 13, 1950 and June 3, 1950. See also Niblo, Mexico in the 1940s: Modernity, Politics, and Corruption, 190, for evidence that Gómez sought to keep competitors out two years later in 1952.

Cotter, Troubled Harvest, 242, also notes that Gómez became the “presta-nombre,” or name-lender, for Worthington in Mexico in order to circumvent laws requiring 51% Mexican ownership of companies.

Novedades, May 16th, 1951.


Jornadas Nacionales, undated, in AMRG.

Zócalo, October 9, 1950. There were also articles accusing him of being an “Henriquista,” or a supporter of Miguel Henriquez Guzman, a Cardenista who would break with the PRI to run an independent campaign against it in 1952.

AMRG, 1950 H-M.

For an exploration of Alemán’s corruption, see Niblo, Mexico in the 1940s. This is not to argue that his predecessors Obregón and Calles were not equally corrupt, just that the scale and scope of corruption reached new heights under Alemán.


From 1948 to 2007, there were a total of 145 according to the CNA. CNA, *Atlas del Agua en México*, http://www.cna.gob.mx/ (accessed March 1, 2010) 2009, 80.

61 Ibid.


64 See Lane Simonian, *Defending the Land of the Jaguar: A History of Conservation in Mexico* (Austin: University of Texas Press, 1995), Chapter 6, for details of the law and of national conservation groups such as “Amigos de la Tierra” (Friends of the Earth), which tried to get the government to enforce it to little avail.


I have no information as of now whether these *ejidatarios* hoped for employment on dairy farms in other areas of the Laguna or whether they would be subcontracted out to raise cattle. It would likely be the former as there was no longer water to pump in Viesca, at least not in the immediate area in question.


For comparison, Worthington’s headquarters in New Jersey employed over 1,000 people. But though the Mexican factories were small with few employees, their efficiency made for mass production capability.

January 29, 1965; untitled newspaper, AMRG.


AMRG, 1951 F-1, Marte R. Gómez to son Rodolfo, October 17, 1951.

Moreno Vázquez, *Por abajo del agua*, 22.


Ibid., 105.

Jornada, *Agua*, 244.


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Irrigación en México
El Siglo de Torreón


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