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The Drying of Texas Agriculture

New Projections Say Irrigated Acreage, Agricultural Water Use, Will Decline

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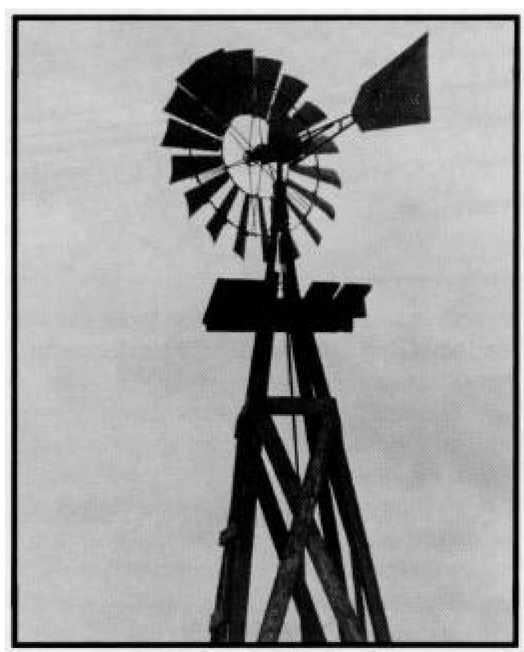
In the 1970s, irrigation water use was at an all time high in Texas. New areas were being irrigated with a seemingly endless supply of water. Just a few years earlier, a grand scheme that had been put before the voters was only narrowly defeated. It would have imported water from the Mississippi River to feed the growing thirst of cotton, sorghum, and other crops, as well as urban uses.



However, based on recent trends the vision of irrigating vast areas of Texas appears to be only a mirage. A combination of factors is reducing irrigated acreage and irrigation water use to some of their lowest levels since the 1950s.

Based on new projections of water use by the Texas Water Development Board (TWDB), the State's water planning agency, these trends of declining irrigation use appear likely to continue. For example, even though irrigation accounts for roughly 70% of Texas' water use now, urban demands are expected to grow to make up roughly half of Texas' water use by the year 2040.

Why is irrigation expected to decline? Irrigation is practiced mainly in the more arid regions of the State where cities and agriculture compete for scarce water supplies. As urban populations increase, their demands for water also rise, often at the expense of irrigated agriculture. Even in regions of the State that get more rainfall, there are conflicts. Abundant water supplies are one of the main reasons rice is a major crop along the Texas Gulf Coast. Growing cities and suburbs are already cutting into the amount of water used for rice irrigation. Significant declines in rice irrigation and rice acreage are expected and some exeperts question whether the industry can survive.

Low crop prices are a major . factor in manyfarmers'decisions not to irrigate. In areas that depend on declining groundwater supplies, overpumping is lowering aquifer levels, making the water more expensive to pump. Federal programs to protect wetlands and highly erodible soils have idled some previously irrigated croplands. Other Federal price support programs which once encouraged maximum production have been restructured to save water.

CURRENT WATER USE

More than 70% of the 6.4 million acrefeet (MAF) of 1990 groundwater use and more than 40% of statewide surface water use is for irrigated agriculture. Groundwater also accounts for 65% of the total water used for irrigation. Surface water contributes less for irrigation because it is often located farther away from the area of use. About 78% of irrigated land area is served by groundwater, 19% by surface water, and 3% by a combination of ground and surface water.

Still, the total amount of water used for irrigation and the number of irrigated acres both dropped sign)ficantly in the 1980s (Figure 1). The amount of water used for irrigation slumped from a record high of 13.1 MAF in 1974 to roughly 9.3 MAF in 1984 and just over 8.8 MAF in 1989. Nearly 6.2 MAF of the 1989 usage was from groundwater (a drop of 10% from 1984) and 2.15 MAF (an increase of 4% from 1984) was from surface water.

By the year 2010, municipal and industrial water requirements are expected to equal the amount used for agriculture (roughly 6.2 MAF).

More than 675,000 previously irrigated acres were converted into dryland farming or taken out of production between 1985 and 1989 because of Federal farm programs, low crop prices, and the increasing scarcity and higher cost of water. Only about 6.75 million acres were irrigated in 1985 (compared to more than 11 million acres used for dryland crop production). More than 6.1 million acres were irrigated in 1989. Roughly 2.4 million acres that were previously irrigated are still equipped for irrigation, but were not irrigated in 1989.

The High Plains account for roughly 65% of the total irrigated acreage in the State, followed by the Lower Rio Grande Valley, North-Central Texas, the Trans-Pecos, and the GuH Coast Prairie (Figure 2A). The 1989 figures represent a sizeable decline from past years for most regions.

Reductions in irrigation activity can be illustrated by looking at the High Plains (Figure 2B). In 1989, producers in the region irrigated only 67% as many acres as in 1974 and the amount of groundwater used for irrigation decreased by 34% (on an average per-acre basis) over that time. Since irrigation began in the region in the 1930s, roughly 23% of the water in the aquifer has been withdrawn, lowering water tables by 100 feet or more in some areas.

Cotton is the most widely grown irrigated crop (planted on 29% of total irrigated acres or 1.8 million acres) followed by wheat (15% or 969,000 acres) and grain sorghum (13% or 843,000 acres) and corn (13% or 805,000 acres). Although cotton has been the most widely grown irrigated crop for some time, irrigated grain sorghum acreage has plummeted from 28% in 1984 to its current level, in part because it can also be grown as a dryland crop. In 1989, roughly 1.8 MAF was used to irrigate cotton, 1.04 MAF for rice, 980,000 AF wheat, and 950,000 AF for grain sorghum.

ESTIMATING IRRIGATION USE

TWDB's new water use projections were developed for two alternative growth scenarios representing high and low series water demand forecasts. Irrigated agriculture estimates are based on the acreage now being irrigated, water use per acre, water costs, and the availability of supplies.

These estimates are based on a continuation of such current trends as relatively high pumping costs, low crop prices, Federal programs, and increasing urban demands. Changes in these factors or, for example, the opening or closing of key export markets may influence how much and what kind of crops farmers produce and how much water they use.

Gradual decreases in irrigated acreage and increases in water use efficiency are anticipated by the TWDB. As a result, the total amount of water used for irrigation is projected to drop substantially in the future compared to previous plans.

The total number of irrigated acres is also expected to decline to between 4.71 (low scenario) to 5.82 million acres (high scenario) by the year 2040.

The new estimates represent a radical departure from projections in previous years.

The most ambitious TWDB plan was proposed in 1968. It called for transporting water from the Mississippi River and East Texas to the High Plains, the Trans-Pecos, the Gulf Coast, and the Lower Rio Grande Valley to provide supplies for irrigation and other uses. The plan predicted that irrigation could be feasible on nearly half of Texas' irrigable lands (16.6 million acres out of 37 million acres) if water was available. More than 10 MAF were expected to be supplied by the system by the year 2020. The total amount needed for irrigation in the year 2020 was projected at 16.6 MAF.

TWDB estimates in 1984 downsized the 1968 projections. Although the high estimate for the year 2020 was projected at 16.2 MAF, new low series estimates for the year 2020 were only 10.7 MAF.

The 1990 plan suggests that few new supplies will be developed for irrigation. It estimates that only between 6.2 (low estimate) and 7.6 MAF (high estimate) will be used for irrigation by the year 2000, and just 5 to 6.7 MAF by the year 2040. The 2040 high case scenario represents a 16% reduction over current water usage, while the low case estimate is equal to a 37% dropoff.

Previous plans tried to estimate the amount of water that would be needed if all the potentially irrigable lands in Texas were developed. In contrast, the 1990 plan estimates the irrigation needs of only those lands already with water that are most likely to be developed. In essence, the new estimates acknowledge that not all potentially irrigable lands can be irrigated in light of water shortages, increasing urban demands, and economic factors.

REGIONAL IMPACTS

The amount of water expected to be used for irrigation varies regionally throughout the State, but the most dramatic declines are expected in West and South Texas (Figure 3).

In many cases, the TWDB's lower water use estimates are a reflection of anticipated water savings due to conservation, not a conversion of irrigated acreage to dryland farming or transfers of agricultural water to urban use. Declines in irrigated acreage are anticipated in the Nueces and Lavaca River Basins.

Irrigation water use is expected to decline in some coastal basins as efficiency increases and acreage decreases, according to TWDB estimates. The Brazos-Coloredo, Colorado-Lavaca, and the LavacaGuadalupe Basins are all expected to use 10% less water by the year 2040.

The amount of water used for rice irrigation could drop substantially. Rice production now accounts for nearly 870,000 AF per year or 84% of all water use in the coastal region served by the Lower Colorado River Authority (LCRA). LCRA projects that the amount of water used for rice irrigation under a low case scenario could be as little as 603,985 AF by the year 2000 and 593,768 by the year 2020. Base case projections are 758,070 in the year 2000 and 744,965 by the year 2020, while high case estimates are 942,527 for the year 2000 and 926,016 by the year 2020.

The way LCRA allocates water may also aggravate water shortages during dry years. LCRA treats irrigation as an "interruptible" water user. Irrigation demands are filled by the amount of water left over after supplies for cities, industries, and in-stream flows are met. If insufficient interruptible water is available, less water for irrigation may be provided. This could eliminate second crop production in dry years.

Water use patterns are expected to change (see Figure 3), especially along the Gulf Coast. In Southeast Texas and the Upper Gulf Coast region, irrigation now accounts for 45% of the area's water use, but the TWDB expects that by the year 2040 urban uses will constitute 65% of the region's water usage. In South Texas and the Lower Gulf Coast region, irrigation water use is anticipated to decrease from 78% to 55% by the year 2040, while municipal use is projected to increase from roughly 20% to 42% during that period.

UNIVERSITY RESEARCH

Estimating trends in irrigation has been an ongoing focus of university research.

Lonnie Jones, an Agricultural Economics researcher at Texas A&M University, developed projections for the Gulf Coast, Rolling Plains, and Gulf Coast regions. Jones says that irrigated rice acreage and irrigation water use in the Gulf Coast could decrease significantly in the future if river authorities shift water from agricultural to municipal use through the use of pricing and other mechanisms, and if Federal price supports are decreased. Jones expects that rice water use will be less efficient than it could be as long as the cost of surface water is low, water use is not monitored, conveyance losses are high, and flooding is used to maximize yields.

Don Ethridge, an Agricultural Economics researcher at Texas Tech University, developed estimates for the High Plains. His studies suggest that irrigated acreage will decrease in the Southern High Plains sooner than in the rest of the region because aquifers are shallow, receive little recharge, and irrigation has been practiced longer. Ethridge estimates that average water use rates in the Northern High Plains may decline because of the conversion of some acreage from corn to wheat production, and conservation. Because the Northern High Plains have more groundwater in storage, irrigation will be practiced longer in this part of the High Plains than in any other part of the region. By the year 2000, nearly 68% of the irrigated acreage and roughly 75% of the irrigation water use in the region is expected to be centered in the Northern High Plains.

Eduardo Segarra of the Agricultural Economics Department at Texas Tech University has been investigating how High Plains farmers will adopt water-saving technologies and change from irrigated to dryland production. The research suggests that conversion of irrigated lands to dryland farming will be the major means of coping with water shortages. His estimates show dryland acreage in the region may increase by more than 20% by the year 2000 as some lands are no longer irrigated and other lands come back into production after their CRP enrollments expire.

The transition of the High Plains from irrigated to dryland farming was the focus of a conference sponsored by the Great Plains Agricultural Council in 1985. Texas A&M University Agricultural Economist Ron Lacewell said that much of Texas will eventually have to be farmed with dryland methods. He predicted that sizeable amounts of acreage will be converted to dryland agriculture each year unless technological change and adoption increases.

THE ROLE OF CONSERVATION

State water planners suggest that conservation will "produce" 1 MAF by the year 2000,1.6 MAF in water savings annually by the year 2020, and roughly 1.7 MAF by the year 2040.

In many cases, water use efficiency and conservation can be increased by 20% or more compared to conventional irrigation systems (Sweeten and Jordan, 1987). In the High Plains, for example, conservation can reduce the water required to irrigate nearly 4 million acres from 4.5 to 3.1 MAF.

To help encourage conservation, Texas voters approved a loan program to increase on-farm water savings in the 1980s. That program is being administered bytheTexas Water Development Board (TWDB). So far, the program has approved 12 loans totaling $6 million to local water districts which in turn loan the money to individual farmers. The farmers can use those funds to purchase efficient irrigation systems and make other improvements. Water savings from the loans have been estimated at more than 100,000 AF annually (TWDB, 1989). However, because some areas are already relatively water use efficient there are questions about how much additional conservation can be generated in the future.

The biggest savings are expected from on-farm conservation practices including Low Energy Precision Application (LEPA) sprinklers, surge flow irrigation, drip irrigation, soil moisture monitoring, and underground pipelines.

LEPA applies small amounts of water near the plant canopy and soil surface to reduce losses to wind and evaporation. When used in combination with furrow dikes, (small earthen dams in the rows that trap rainfall or irrigation water) application efficiency jumps from 65% to more than 90%. As many as 2 million acres could be converted from conventional sprinkler systems to LEPA systems. The system often pays for itself in 2 to 7 years because of reduced pumping costs. There are roughly 4,500 LEPA and other lower pressure systems and few high- pressure sprinklers are still operating in the region.

Surge systems send water down the furrows in pulses that apply water more uniformly throughout the field and reduce tailwater runoff. Improvements of 15 to 20% are commonly achieved by converting traditional furrow systems to surge irrigation. Surge was used on roughly 1 million acres in 1985 (Smerdon and Blair).

Drip irrigation saves water by applying it directly to individual plants or rows through flexible tubing equipped with emitters. This technique virtually eliminates evaporation and runoff and can reduce water use by 20 to 30%. More than 40,000 acres in Texas now use drip irrigation, but so far the technology is expensive and restricted to orchards and other high value crops.

Monitoring soil moisture to assess how much irrigation needs to be applied increases efficiency by preventing over-irrigation. This technique could be used on almost all farmland in Texas.

Using underground pipelines and lining earthen canals with concrete can decrease seepage and evaporation losses by 20 to 30%. Roughly 22,000 miles of underground pipelines are now used on 4.9 million acres but could also be installed on 1.3 million more acres. Roughly 1,200 miles of concrete lined ditches now convey water to 155,00 acres. In the High Plains, more than 12,000 miles of underground pipeline has been installed on roughly 2.2 million acres.

Water savings are also being reported in rice irrigation. Garry McCauley of the Texas Agricultural Experiment Station at Beaumont has been working with the LCRA and other agencies to develop new rice varieties and management techniques including shallow flooding, fewer flushes, land leveling and others as part of a comprehensive program called "Less Water-More Rice." Reductions of 70,000 AF have been reported since 1986 throughout the Coastal Rice Belt and savings of an additional 65,000 AF are achievable (Personett, 1990).

The overall impact of utilizing conservation technologies and management strategies is unclear. Previous studies at Texas A&M University (Ellis and others, 1985) suggest that implementation of LEPA and surge irrigation may not extend the useful life of groundwater supplies in the High Plains because they will encourage irrigation of more acreage.

Other factors also influence conservation. Soil amendments like vanadium have been studied that could increase the water use efficiency of cotton plants by altering the way the plant grows. New varieties of crops and plants are being developed that need less irrigation and better withstand droughts. Increasing the efficiency of pumping plants can also reduce waste.

THE CRP AND OTHER FEDERAL REGULATIONS

The impact of Federal farm policies on irrigation water use and irrigated acreage is unclear at best. Some critics charge that current farm price support programs result in excessive use of water and other inputs by providing maximum payments to farmers with the highest yields. Others suggest that policies such as the Conservation Reserve Program (CRP) may have only a minimal impact on reducing irrigated acreage and irrigation water use because only marginally productive lands that are not highly irrigated are typically enrolled.

A study by the USDA Economic Research Service suggests roughly 68% of the marginal irrigated acreage enrolled in the CRP through 1987 was in Texas and Nebraska (Schaible, 1989). Nationally, however, marginally irrigated land makes up less than 2% of the acres enrolled. Farmers who pump groundwater from aquifers like parts of the Ogallala with low well yields and high pumping costs are more likely to take part in the CRP, because reverting to dryland farming is more risky. More than 800,000 acres in the Southwest with pumping lifts of more than 300 feet were identified as most likely to be enrolled in the CRP (Figure 4). The study also showed that CRP participation may not be reducing overall water use in all cases. In many cases, water that would not have been used on CRP acreage was instead used to fully irrigate crops that received only limited irrigation previously. Finally, enrolling roughly 700,000 to 850,000 acres of marginally irrigated land in the CRP could benefit the Southern Plains region by $10 to $14 million over 40 years by reducing groundwater depletion and pumping costs.

Under the CRP, roughly 3.9 million acres of previously farmed lands have been taken out of production in Texas. More than half of the eligible acreage in the Southern Plains of Texas and Oklahoma was enrolled in the CRP as of 1989. Roughly 36% of these lands have been in the High Plains and Rolling Plains, while 85% of the CRP enrolled acreage in the State was in Central and West Texas.

Other estimates suggest that the CRP will idle some irrigated lands in the Southern High Plains since many profitable low-residue crops and some cropping practices are not allowed in the program (Segarra and others, 1990). The program will also help limit the spread of future irrigation because wetlands and playa lakes may be prohibited from being converted into new farmlands.

The economic effect of complying with CRP provisions was analyzed in a High Plains case study carried out by James Richardson of the Texas A&M University Agricultural Economics Department and Bill Harris of the Texas Agricultural Extension Service (Richardson and others, 1989). The study utilized a computer model which simulates the effect of farm programs on the economic viability of typical farms to assess the impact of complying with the CRP on farm income. Results suggest that the most profitable scenario is to plant high residue cover crops in combination with low residue crops. Still, even this scenario allows farmers to only break even. In other words, CRP enrollment doesn't significantly increase farm income.

The impact of Federal farm policies on the conversion of irrigated to dryland farming in the High Plains was the focus of a study by Ron Lacewell of the Texas A&M University Agricultural Economics Department. Lacewell believes that Federal price support programs may be limiting the adoption of water-conserving crop rotations, thus encouraging excess water use. Lacewell simulated three farm policy scenarios (continuation of the current program, non-participation by producers, and a program which allowed more flexible crop rotations). Results show that giving farmers more options in crop selection would increase profits, but would boost groundwater pumpage. Farmers who didn't participate in Federal programs used the least amount of water.

James Mjelde, Ed Rister and Ron Griffin of the Agricultural Economics Department at Texas A&M recently conducted a study that examined whether Federal programs influence the amount of inputs farmers apply (Mjelde and others, 1991). It suggests that Federal programs may slightly influence the per-acre use of water, fertilizer, and pesticides because farm program payments are now based on frozen program yields. The study also suggests that uncontrollable factors like climate, need to be factored in to such analyses to get accurate estimates of on-farm conditions.

The amount of irrigated rice acreage in Texas is heavily influenced by Federal price support policies. Programs that allowed farmers to set aside much of their acreage while receiving full government payments caused a substantial drop in the number of acres irrigated from 1982 to 1987. However, much of that idled acreage re-entered production in 1988 (LCRA, 1988).

ECONOMIC ISSUES

Irrigation contributes significantly to Texas' economy. Irrigated crops grown in Texas were worth more than $1.25 billion in 1985. The overall value of irrigation to the Texas economy was nearly $3.7 billion. In contrast, dryland agriculture totaled $3.05 billion in crop sales and was valued at more than $10 billion overall because so much more acreage was not irrigated.

Declining aquifer levels, high energy costs for pumping groundwater, and low farm profits are causing major changes in irrigation in the High Plains, according to recent studies by the U.S.D.A./ Agriculture Research Service (Musick and others 1987). The study showed that furrow irrigated crops declined by 40% since 1974, while sprinkler irrigated areas expanded during that time. Much of the previously furrow irrigated land is no longer irrigated. The research also suggests that the Northern High Plains will be slower to adopt conservation technologies than other parts of the region because water supplies are more abundant.

The economic viability of the Texas rice industry is a focal point of research of Ed Rister of the Texas A&M University Agricultural Economics Department. Work in progress by Rister and others is comparing the costs and benefits for rice production using groundwater and surface water rates from the LCRA and the Lower Neches Valley Authority near Beaumont. Different levels of participation in farm programs are also factored in. Preliminary results of the simulations show that the profitability of rice farming is marginal at best, particularly if water prices increase (Rister, 1991). Profitability could increase as new technologies are advanced and adopted. Many farmers may respond to higher water prices by eliminating second crops.

One-year contracts for irrigation water have been made available in the lower Brazos River Basin and some see this as a sign prices could be more volatile and higher in the future. LCRA has developed a simulation model that will help farmers and policy makers evaluate the economic benefits and risks of varying levels of irrigation based on planted acreage, the amount of available water, and other factors (Martin, 1990). In some years, LCRA may not be able to supply water for ratoon crops and this could also decrease farm incomes.

WATER MARKETING

Water marketing (the sale or transfer of water or water rights from one user to another) is also influencing irrigation levels, particularly in the Lower Rio Grande Valley.

Ron Griffin and Chan Chang of the Agricultural Economics Department at Texas A&M University, have been analyzing how much marketing has taken place. Their research (1991) shows that 75,000 AF of water rights have been transferred from agricultural to urban use in South Texas and that nearly half (45%) of all municipal water rights in the region have been obtained through water marketing in the last 20 years.

Still, agricultural users hold roughly 88% of the water rights in the region (cities have only 8%). Many observers predict that irrigation will still use 70 to 80% of the water in the region in the future, even after cities obtain all the water supplies they need.

SUMMARY

Many estimates suggest that over the next 50 years the amount of water used for irrigation will decline significantly. In particular, the new Texas Water Plan acknowledges, for the first time, that many potentially irrigable lands will probably never be irrigated and that future irrigation levels will decrease.

The decreases in irrigation water use can be attributed to a number of factors including increasing urban demands, conservation, poor on-farm economic conditions and Federal farm policies. Additional money may need to be provided to allow irrigators to adopt conservation technologies.

In some cases, the increased cost of irrigation water or the decreases in supplies due to the initiation of interruptible water sales (particularly in the Lower Colorado and Brazos River Basins) will make irrigated agriculture less viable. Although decreases in overall agricultural water use can benefit other sectors of Texas' economy by providing more water for "high value" uses, the economic impact of irrigation in Texas should not be under-valued.

Finally, much of Texas' irrigation takes place in the High Plains and significant reductions in irrigation are expected there. However, it seems unlikely that water savings in that Region will contribute to solving water problems in other parts of the State.

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