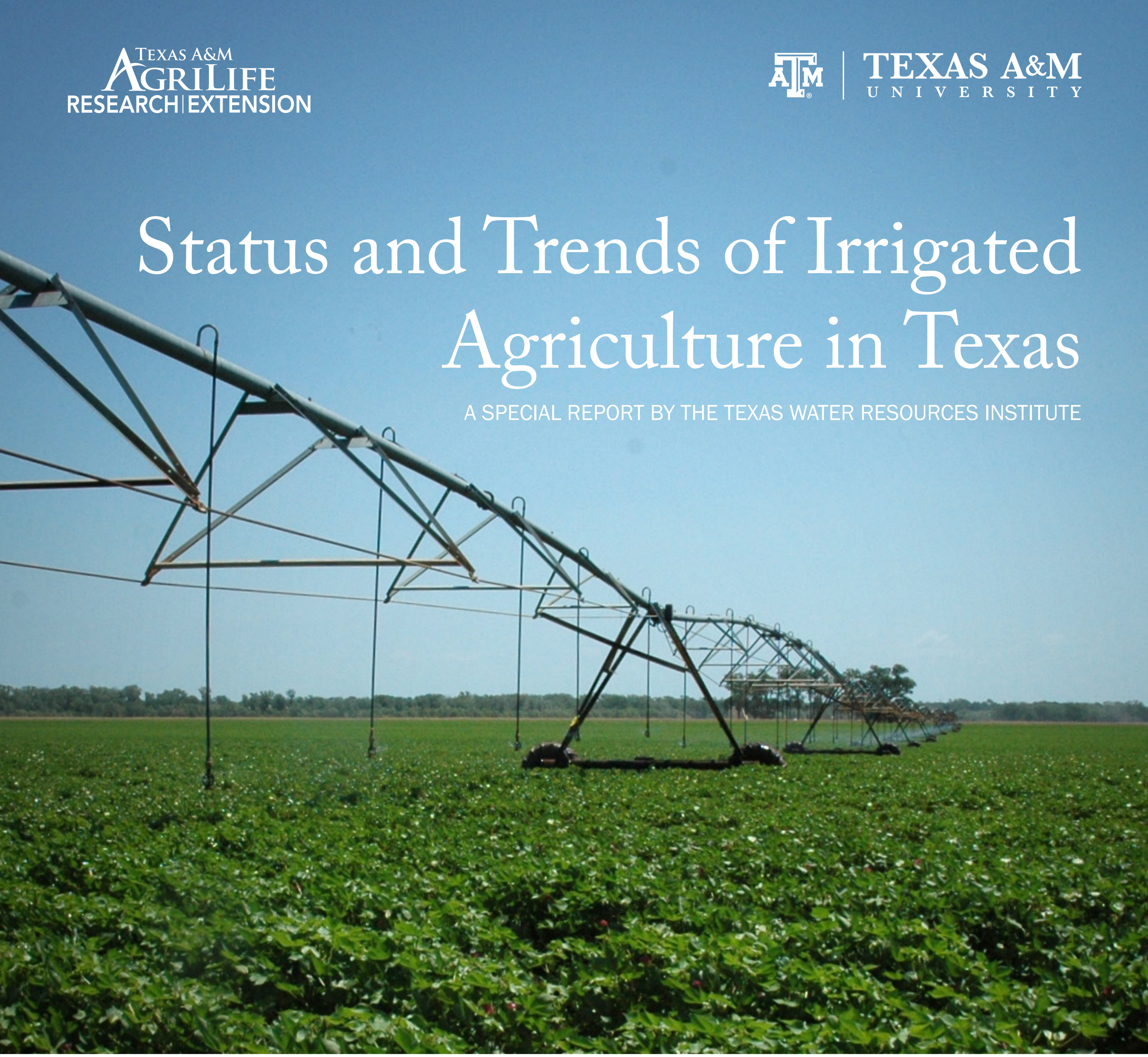
Texas A&M AgriLife Research | Extension

Texas A&M University



# Status and Trends of Irrigated Agriculture in Texas

A SPECIAL REPORT BY THE TEXAS WATER RESOURCES INSTITUTE

**Irrigation is critical to our food production and food security and is a vital component of Texas' productive agricultural economy. Texas ranks third in the United States in both agricultural acres irrigated and irrigation water applied. Significant advances have been made in irrigation efficiency; however, challenges remain. The following information is drawn primarily from data and reports published by the Texas Water Development Board, the U.S. Department of Agriculture National Agricultural Statistics Service, and Texas A&M University. Together these sources provide valuable perspective on the status and trends of irrigated agriculture in Texas.**

Texas Water Resources Institute
*make every drop count*

Kevin Wagner, Ph.D.
With significant contributions from faculty and staff of the Texas Water Resources Institute, Texas A&M University, Texas A&M Institute of Renewable Natural Resources, USDA-Natural Resources Conservation Service, Texas Farm Bureau, Texas State Soil and Water Conservation Board, and Texas A&M AgriLife Research and Extension Service.

2012
TWRI EM-115
twri.tamu.edu

## Over 6 Million Acres Irrigated for Agricultural Production

- One out of four harvested cropland acres in Texas is irrigated (USDA-NASS 2008).
- Irrigated acres in the state have remained relatively steady (Figure 1) for a quarter century (TWDB 2001, 2011).
- As of 2008, Texas had 6.17 million irrigated acres, making up more than 10% of the irrigated acres in the United States (TWDB 2001, 2011).

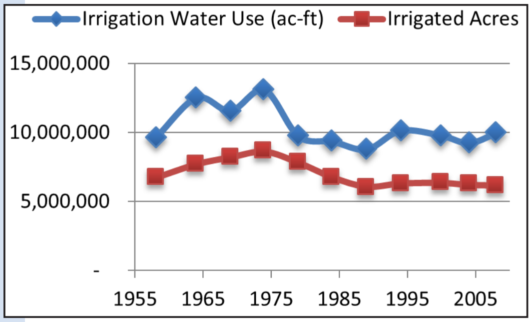



Figure 1. Irrigated acres and irrigation water use in Texas, 1958–2008 (TWDB 2001, 2011).

## Importance of Groundwater to Agricultural Irrigation

Although both surface water and groundwater are used for agricultural irrigation, the source of most agricultural irrigation water is groundwater. In 2000, 86% of the irrigated acres in the state used groundwater, 11.6% used surface water, and the remaining 2.4% used a mix of groundwater and surface water (TWDB 2001).

Groundwater is the sole source of irrigation water in the Texas High Plains, while the Rio Grande Basin and upper portions of the Gulf Coast rely heavily on surface water. Combinations of sources provide irrigation water for the Winter Garden (predominantly groundwater) and middle Gulf Coast (predominantly surface water) regions (TWDB 2011).

## Agricultural Irrigation Concentrated in Areas Far from Urban Growth

The state's irrigated acres are concentrated in those areas having both productive soils and available water. As shown in Figure 4, most agricultural irrigation is in West and South Texas, far from the state's major urban centers in Central, North, and Southeast Texas.

Annual estimated water use in Texas totaled 16.2 million acre-feet in 2009, with about 57% used for agricultural irrigation (TWDB 2012). Total annual irrigation water use has remained steady, averaging approximately 9.5 million acre-feet, since the late 1970s (Figure 1).

On a per acre basis, the rate of irrigation application in Texas has averaged less than 18 inches annually since the 1950s (TWDB 2001). Although these rates vary by region and crop, on a statewide basis agricultural irrigation rates are comparable to or less than the rate of application by homeowners. On an annual basis, warm season turf grasses will use 40 to 60 inches of water per year (Duble). A 3-year study in College Station found average households supplemented rainfall by applying 22 inches of water annually to their lawns and landscapes (TWRI 2004).

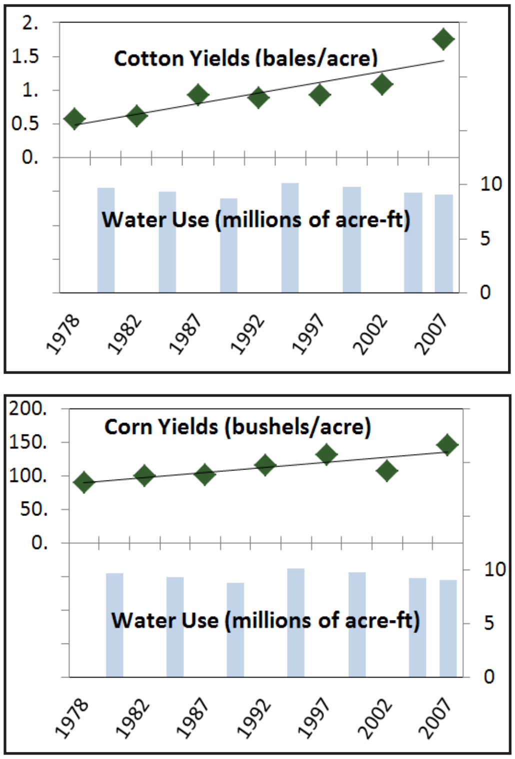



Figure 2. Increases in cotton and corn yields (USDA-NASS 2008) in comparison to statewide agricultural irrigation use in Texas (TWDB 2001, 2011).

## Increasing Yields without Increasing Water Use

While statewide agricultural irrigation application rates have stayed relatively constant since the mid-1970s (TWDB 2001, 2011), agricultural yields have increased significantly as improvements in irrigation technology and management, crop management, and crop genetics have been developed and implemented. For example, Figure 2 shows that average per-acre corn yields have increased by 62% since 1975 while cotton yields have more than doubled (USDA-NASS 2008).

**Texas agricultural irrigation averages less than 18 inches per acre annually. In comparison, a College Station study found average households applied 22 inches annually to lawns (TWRI 2004).**

Although crop genetics have helped increase productivity, improved genetics do little without water. In comparison to non-irrigated crops (dryland production), irrigation generally doubles crop production (Figure 3). Equally important, irrigation helps mitigate production risk in the state's semi-arid climate while also improving crop quality and value.

**Irrigation doubles crop yields, helps mitigate production risk, and improves crop quality and value.**

## Water Supply and Demand Challenges

Water availability challenges the state's future more than any other natural resource issue. Demand already exceeds supplies in six of the 16 water planning regions (Figure 4). By 2060, demand will exceed supplies in all regions except two.

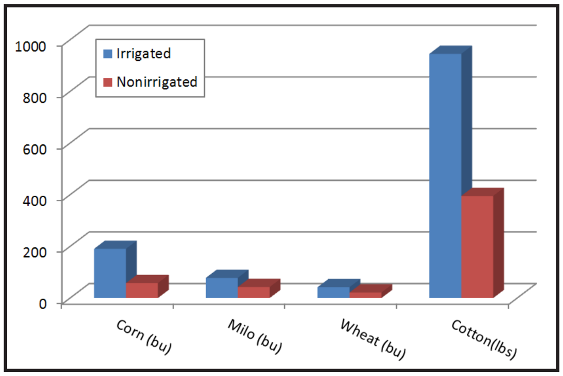


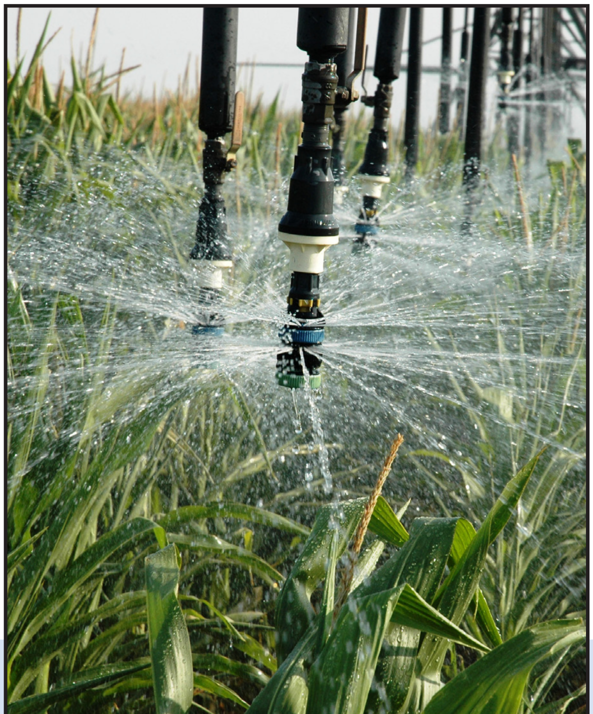

Figure 3. Comparison of average crop yields in 2008 and 2009 (on a per acre basis) with and without irrigation (USDA-NASS).

*Declining Aquifer Levels, Especially in the Ogallala Aquifer*
By 2060, statewide groundwater supplies are projected to decrease by 32%, primarily because of declining Ogallala Aquifer levels and restricted pumping in the Gulf Coast Aquifer to prevent land subsidence (TWDB 2011).

*Increasing Urbanization*
Rapid development and expansion of urban areas are decreasing the amount of land available for irrigated agriculture, and this is especially noticeable in Regions M and E. Many of these acres are being converted to residential areas with significant quantities of irrigated urban landscapes.

Further, surface water supplies available for agricultural irrigation are decreasing as water demands for municipal, industrial, and energy sectors increase (Figure 4). In Regions C, K, and M, municipal demand increases of more than 90% are expected by 2060 (Table 1). The tremendous pressure from urban growth is forcing many areas to look to obtaining water from other regions.

With the projected doubling of the population of Texas over the next 50 years, sustaining irrigated agriculture will become ever more challenging because of the competing interests generated by this growth. It will also become more important with the increasing food demands of this population and need for a secure food supply.




Low-pressure sprinkler irrigation in the High Plains (left) and a center pivot irrigation system at the Texas A&M AgriLife Research and Texas A&M AgriLife Extension Service farm in the Brazos River Valley (right).

Figure 4. Existing (as of 2010) and future (2060) water demands for each water use category in each water planning region (TWDB 2012).

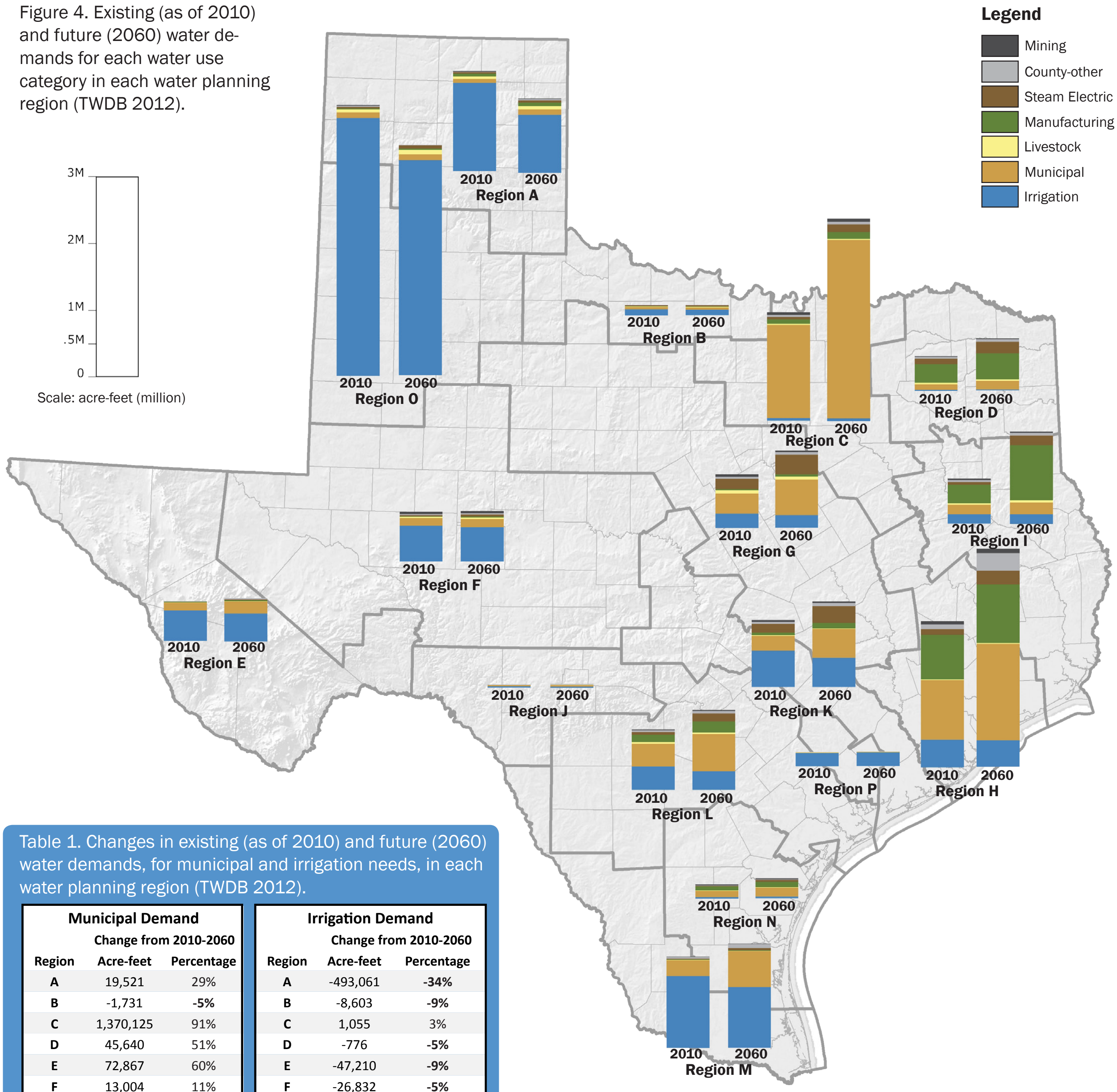



Table 1. Changes in existing (as of 2010) and future (2060) water demands, for municipal and irrigation needs, in each water planning region (TWDB 2012).

**Municipal Demand**

| | Change from 2010-2060 | |
|---|---|---|
| Region | Acre-feet | Percentage |
| A | 19,521 | 29% |
| B | -1,731 | -5% |
| C | 1,370,125 | 91% |
| D | 45,640 | 51% |
| E | 72,867 | 60% |
| F | 13,004 | 11% |
| G | 244,596 | 75% |
| H | 589,757 | 61% |
| I | 37,753 | 25% |
| J | 4,411 | 21% |
| K | 228,062 | 95% |
| L | 227,925 | 62% |
| M | 321,519 | 124% |
| N | 40,405 | 40% |
| O | 6,447 | 7% |
| P | 251 | 5% |

**Irrigation Demand**

| | Change from 2010-2060 | |
|---|---|---|
| Region | Acre-feet | Percentage |
| A | -493,061 | -34% |
| B | -8,603 | -9% |
| C | 1,055 | 3% |
| D | -776 | -5% |
| E | -47,210 | -9% |
| F | -26,832 | -5% |
| G | -24,155 | -10% |
| H | -19,245 | -4% |
| I | 1,940 | 1% |
| J | -3,586 | -18% |
| K | -120,942 | -21% |
| L | -77,347 | -20% |
| M | -181,886 | -16% |
| N | 3,842 | 15% |
| O | -711,855 | -17% |
| P | -18 | 0% |

**Irrigation efficiency has gone from 60% to 88–95% in much of the state today, allowing Texas to get much more value and agricultural output from its water.**

## Mass Conversion to Efficient Irrigation Systems

Historically, most agricultural irrigation was applied using flood and furrow irrigation; however, most of the state has undergone a mass conversion from these systems to more efficient irrigation systems (Figure 5). Beginning in the late 1970s, center pivot irrigation systems became reasonably available, and by 1994 they had been adopted on nearly half of Texas' irrigated acres. During that time, center pivots evolved from high-pressure machines that sprayed water over the crop canopy to eminently more efficient, low-pressure systems that gently apply water at or below a crop's canopy.

Compared to traditional flood or furrow irrigation methods, modern center pivot sprinklers offer a tremendous improvement in application efficiency along with reduced labor requirements and usually large increases in yield. Both energy and water use efficiency are also greatly enhanced when low-pressure center pivot systems are used.

As of 2008, center pivot sprinklers are used on nearly 80% of Texas' irrigated acres, and 87% of those acres are using low-pressure center pivot sprinklers. Furrow and flood irrigation account for less than 20% of irrigated acres today. Further, the highly efficient subsurface drip irrigation, in which there is minimal evaporative loss, is increasingly being adopted and now comprises almost 3% of irrigated acres (Figure 6).

Because of this adoption, irrigation efficiency has gone from 60% to 88–95% in much of the state today, allowing Texas to get much more value and agricultural output from its water.

Agricultural irrigation technology continues to progress and farmers are largely ready and willing to adopt more efficient operations that save water, energy, and money. The USDA-Natural Resources Conservation Service and Texas State Soil and Water Conservation Board report that through their programs alone, farmers in Texas have improved irrigation water management on over one million acres since 2008. This reflects only a portion of the improvements adopted.

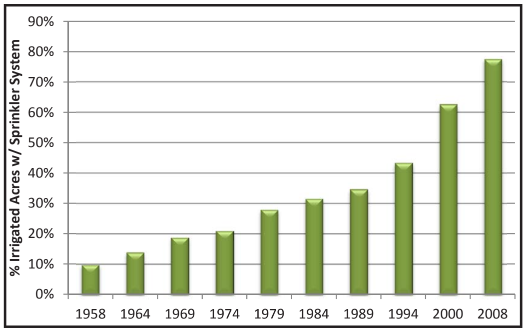



Figure 5. Percentage of irrigated acres with sprinkler irrigation system (Anderson 2010; TWDB 2001, 2011; USDA-NASS 2008).

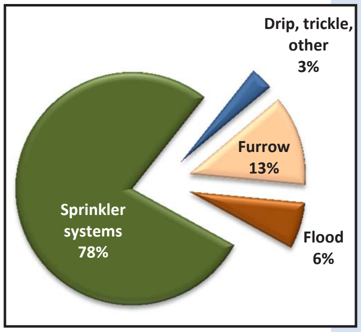



Figure 6. Percentage of irrigated acres by sprinkler, subsurface drip irrigation, furrow and flood irrigation (USDA-NASS 2008).

## Economic Impacts of Irrigated Agriculture

Many communities depend on irrigated agriculture for continued viability. The statewide economic value directly derived from irrigated agriculture was $4.7 billion in 2007 (TWDB and TSSWCB 2012).

However, impacts of irrigation vary by region. In the Texas High Plains, the total regional economic impact of converting all irrigated acres to non-irrigated dryland farming would be an annual net loss of over $1.6 billion of gross output, over $616 million of value added, and nearly 7,300 jobs (Yates et al. 2010). Loss of irrigation in the Winter Garden (Frio, Medina, Uvalde, and Zavala counties) would result in a loss of $55 million in vegetable and melon production, $22 million in additional economic activity, and 872 jobs (AgriLife Extension 2009). In Uvalde County alone, total economic impact of irrigated agriculture is estimated at $44 million and supports 600 jobs (AgriLife Extension 2009b). Finally, in the rice-producing middle Gulf Coast region (i.e. Colorado, Matagorda, and Wharton counties), the irrigation-dependent rice industry contributed $441 million in annual output to the region and supported 3,900 jobs across all sectors (based on 2008–2010 data) (Dudensing and Falconer 2011).

The economic costs of lost irrigation are due to not only reduced production and associated processing, but also to reduced demand for inputs such as fertilizer, chemicals, energy, and machinery. All these factors are linked throughout the state's economy (Yates et al. 2010).

**The statewide economic value directly derived from irrigated agriculture was $4.7 billion in 2007 (TWDB and TSSWCB 2012).**

## Opportunities for Improving Agricultural Irrigation Efficiency

The agricultural sector responds to change, and farmers and ranchers have demonstrated that resiliency by adapting to changes in water supplies, costs, and regulations. Projections in the 1970s suggested that the Ogallala Aquifer would be exhausted by the early 2000s, but producers responded by using newly developed efficient technologies, and the projections did not come true. Opportunities remain for continued improvements in water use efficiency, including the following:

### *Improving Irrigation Scheduling*

Using evapotranspiration (ET) networks and other tools for irrigation scheduling can significantly save irrigation water. ET networks typically consist of strategically placed weather stations that gather data, which is used to provide estimates of crop water needs. Irrigators can then use this information to determine optimum irrigation management on a daily basis. In the 2011 Region A water plan, irrigation scheduling through use of the North Plains ET network is projected to save over 1 million acre-feet cumulatively in the region over the 50-year planning horizon for less than $9/acre-foot. Multiple ET networks have been established in Texas, but the lack of dedicated funding sources often results in disrupted data, limiting the networks' availability and sustainability.

### *Adopting Drought Tolerant Crop Varieties*

Scientists from both the public and private sector are developing germplasm in crops that improves heat and drought tolerance. Some seed companies are currently releasing the first generation of "drought-tolerant" corn hybrids, with many more being developed. Adoption of these varieties may provide significantly more productivity under hot and dry conditions.

### *Developing Improved Irrigation Water Management Technologies*

Continued development and integration of technologies focused on monitoring soil moisture and plant stress along with precision application systems are critical to improving water use efficiency. To provide irrigators the needed tools to help apply water only when it is needed and in the right amounts, evaluation of how to incorporate existing soil moisture technologies into production systems, continued development of plant stress monitoring, and precision application is necessary.

### *Continued Adoption of Conservation Practices*

Further adoption of on-farm conservation practices is also needed to meet conservation goals. These practices include conservation tillage, use of growth regulators and evaporation suppressants, rainfall capture and retention in the soil profile, and runoff reduction from fields (TWDB 2001). Education and economic incentives are needed to encourage more rapid and widespread voluntary adoption of these technologies.

### *Improving Irrigation Conveyance Systems*

Improvement is needed in irrigation water conveyance systems (e.g., canal lining, etc.) to increase their efficiency and reduce water losses.

## Agricultural Irrigation in Texas: Making Every Drop Count

Agricultural irrigation is important to Texas, doubling crop yields, improving economic viability and sustaining communities. Not only is agriculture an important part of the broader food and fiber sector—which accounts for 9% of the state's economy—it also provides food security for Texans by minimizing their reliance on imported food and fiber.

Texas is at the forefront of efficient water resource management, and irrigation conservation is an important component of the state's water strategy. In fact, 12 of the 16 regional water planning groups identified irrigation conservation as a recommended water management strategy to help provide 1.5 million acre-feet to meet future needs (TWDB and TSSWCB 2012).

Agricultural producers have adopted new technologies and significantly improved water use efficiency over the last few decades. Texas agriculture has prevailed in the past and, though challenges remain, will continue to address these complexities with its "can do" attitude, efficiently producing valuable food and fiber.

***References:***


Anderson, C., and Gleaton, C. 2010. Facts About Texas and U.S. Agriculture. Texas AgriLife Extension Service Department of Agricultural Economics. May 2010.

AgriLife Extension. 2009. Economic Impacts of Agriculture and Recreation in the Winter Garden. CNAS Issue Brief 2009-03. Texas AgriLife Extension Service. March 10, 2009.

AgriLife Extension. 2009b. Economic Impacts of Irrigation in Uvalde County, Texas. Texas AgriLife Extension Service. CNAS Issue Brief 2009-02. February 2, 2009.

Dudensing, R., and Falconer, L. 2011. 2006-2010 Economic Contribution of Colorado, Matagorda, and Wharton County Rice Production and Milling. Texas AgriLife Extension Service. May 2011.

Duble, R. L. Water Management on Turfgrasses. Texas AgriLife Extension Service. aggie-horticulture.tamu.edu.

TWDB. 2001. Texas Water Development Board Report 347 – Surveys of Irrigation in Texas, 1958, 1964, 1969, 1974, 1979, 1984, 1989, 1994 and 2000. August 2001.

TWDB. 2011. Texas Water Development Board Report 378 – Irrigation Metering and Water Use Estimates: A Comparative Analysis, 1999-2007. July 2011.

TWDB. 2012. Water for Texas – 2012 State Water Plan. Texas Water Development Board, January 2012.

TWDB and TSSWCB. 2012. An Assessment of Water Conservation – Report to 82nd Legislature, Texas Water Development Board, Texas State Soil and Water Conservation Board. March 2012.

TWRI. 2004. How Much Water is Enough? Using PET to Develop Water Budgets for Residential Landscapes. Texas Water Resources Institute Technical Report 271.

USDA-NASS. 2008. 2007 Census of Agriculture: 2008 Farm and Ranch Irrigation Survey. USDA National Agricultural Statistics Service.

Yates, J., Smith, J., Pate, J. Weinheimer, R. Dudensing, and J. Johnson. 2010. Regional Economic Impact of Irrigated Versus Dryland Agriculture in the Texas High Plains. 2010 Beltwide Cotton Conference Proceedings. January 4-7, 2010.


*Photo credits: Texas A&M AgriLife Research and Extension Service.*