# Regional Water Use Changes on the Horizon

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## INTRODUCTION

The dairy industry in the United States has seen production shift from the northeast and Midwest to the more arid Western region. Today, the dairy industry in 4 of the top 10 dairy states in the nation (CA, ID, NM, and TX) relies upon irrigation to grow the forage crops consumed in the rations fed to their cows. In addition, Washington state producers purchase a significant portion of the alfalfa hay they feed from the irrigated eastern portion of that state. The remaining top 10 milk producing states (WI, NY, PA, MN, and MI) are not as dependent upon irrigation to grow the crops used in their rations.

According to Kenny et al. (2009) the United States withdraws 460,000,000 acre-ft/yr of water annually, with nearly one-half of the withdrawals for thermoelectric power generation and 31 % for crop irrigation. The top 3 states for water withdrawals are CA, TX, and NM with a combined total of 103,200,000 acre-ft/yr, with irrigation accounting for 53 % and livestock 0.54 % of the total water withdrawals in those states. As depicted in Table 1, the irrigation water application rate varies considerably from state-to-state, as does the type of irrigation and the source of the water withdrawals.

Although nationally about 80 % of total water withdrawn is from surface water, ground water reserves are critical in some areas (Kenney et al., 2009). The Ogallala aquifer is a major underground water resource stretching through portions of 8 states from SD; through western KS, eastern CO, and the OK panhandle; and into the panhandle of Texas and eastern NM. Currently it is estimated that the Ogallala contains < 3 billion acre-ft of water, with approximately 12 % of that storage capacity in TX and 1.5 % in NM (McGuire et al., 2003).

## REGIONAL WATER RESOURCES

Each state establishes its own laws governing the water resources within its borders. Most states have been developing some type of water management plan to conserve this precious resource. A summary of the agency responsible, key website(s), type of law, statutes governing, and some key facts follows for several states in the region.

### Arizona

***Agency Responsible:*** Arizona Department of Water Resources
***Website:*** http://www.water.az.gov
***Type of Law:*** Doctrine of prior appropriation
***Statutes:*** Arizona Revised Statutes, Title 45
***Key Facts:*** The groundwater Code was enacted in 1980 with the following goals - 1) control overdraft 2) allocate limited ground water resources, and 3) augmentation of groundwater supply through water supply development. There are 4 water resources in Arizona - Colorado River water, surface water other than Colorado River water, ground water, and

**Table 1.** Variation in source and application rate for irrigation water withdrawals in 2005 for select dairy states (Adapted from Kenny et al., 2009).

| State | Irrigated land (acres, 000) Type of irrigation | | | Withdrawals (acre-ft/yr, 000) Source | | Application Rate (Acre-ft/Acre) |
|---|---|---|---|---|---|---|
| | Sprinkler | Micro-irrigation | Surface | Ground-water | Surface water | |
| CA | 1,460 | 2,650 | 4,940 | 9,660 | 17,700 | 3.02 |
| ID | 2,310 | 4.57 | 1,220 | 4,340 | 14,200 | 5.26 |
| AZ | 213 | 21 | 716 | 2,540 | 2,850 | 5.68 |
| CO | 1,150 | 3.16 | 1,880 | 2,600 | 11,200 | 4.56 |
| KS | 2,780 | 13.0 | 330 | 2,940 | 128 | 0.98 |
| NM | 408 | 19.1 | 441 | 1,420 | 1,730 | 3.64 |
| OK | 384 | 1.91 | 86.9 | 405 | 150 | 1.17 |
| TX | 4,060 | 74.7 | 2,070 | 6,860 | 1,890 | 1.41 |

effluent. Arizona has 4 *Active Management Areas* covering 13 % of the land and 80 % of the population. In *Irrigation Non-Expansion Areas* (**INA**), restrictions prohibit increasing the number of acres that are irrigated in the area.

**Colorado**

***Agency Responsible:*** Colorado Division of Water Resources (also known as Office of State Engineer), Colorado Ground Water Commission, Colorado Water Conservation Board
***Website:*** http://water.state.co.us/
***Type of Law:*** Doctrine of prior appropriation
***Statutes:*** State Constitution Article XVI, sections 5 to 8; Colorado Revised Statutes, Title 37: Water and Irrigation; and Ground Water Management Act of 1965
***Key Facts:*** In 1879, CO passed the nation's first laws to distribute water to its citizens. There are 8 basins and 13 local ground water management districts within the basins. Each division has its own Water Courts System. Colorado water law also claims rainwater and prohibits its diversion to protect senior water rights.

**Kansas**

***Agency Responsible:*** Kansas Department of Agriculture, Division of Water Resources
***Website:*** http://www.ksda.gov/dwr/
***Type of Law:*** Vested rights, pre-June 28, 1945 and doctrine of prior appropriation since
***Statutes:*** K.S.A. 82a-702. Dedication of use of water. All water within the state of Kansas is hereby dedicated to the use of the people of the state, subject to the control and regulation of the state in the manner herein prescribed.
***Key Facts****:* In 1917 the Kansas Water Commission was created with a division of irrigation established in 1919. Both were abolished in 1927 and the Division of Water Resources was established. The Kansas Water Office and Kansas Water Authority were created in 1981, replacing the Kansas Water Resources Board which had been established in 1955. The State Water Resources Planning Act was enacted in 1963.

**New Mexico**

***Agency Responsible:*** New Mexico Office of the State Engineer
***Website:*** http://www.seo.state.nm.us/
***Type of Law:*** Doctrine of prior appropriation
***Statutes:*** New Mexico Statutes, Chapter 72
***Key Facts:*** All ground and surface waters belong to the public. The Water Resources Allocation Program (**WRAP**) is responsible with the State Engineer for administering the water rights program. The groundwater code was enacted in 1931. Currently 39 declared underground water basins exist within the state.

**Oklahoma**

***Agency Responsible:*** Oklahoma Water Resources Board
***Website:*** http://www.owrb.ok.gov/util/waterfact.php
***Type of Law:*** Doctrine of prior appropriation
***Statutes:*** Oklahoma Statutes Title 82. Water and Water Rights; Title 785. Oklahoma Water Resources Board; Chapter 30. Taking and Use of Groundwater; and Chapter 20. Appropriation and Use of Stream Water
***Key Facts:*** Oklahoma has 23 major groundwater basins with the largest being the Ogallala Aquifer. Original Oklahoma Groundwater Law was adopted August 26, 1949 and repealed July 1, 1973 when the Ground Water Act became effective.

**Texas**

***Agency Responsible:*** Texas Commission of Environmental Quality, Texas Water Development Board (planning and project financing)
***Websites:*** http://www.tceq.texas.gov/; http://www.twdb.state.tx.us/
***Type of Law:*** Surface water – doctrine of prior appropriation after domestic and livestock uses, both perpetual rights and limited-term rights; Groundwater – rule of capture (supported by courts since 1904; Fipps, 2002)
***Statutes:*** Texas Water Code
***Key Facts:*** Groundwater law is based on English common law following a 1904 Texas Supreme Court ruling. Texas has 9 major and 20 minor aquifers. There are 7 major water basins as well. Currently there are 98 groundwater conservation districts and one is pending confirmation.

## LEGISLATIVE MANDATED CHANGES IN TEXAS

Water laws in the various states have evolved over time. Since there is insufficient time to review changes in each individual state, some of the major legislative mandates in Texas and how they are being implemented will be used as an example.

On June 1, 1996 the 75th Texas Legislature passed what is commonly referred to as Senate Bill 1, which amends the Texas Water Code effective September 1, 1997. The amendments required regional water districts to be determined by the Texas Water Development Board. Each regional water district was to create a region specific water management plan which had to be adopted by Sept. 1, 2000. Each regional plan was to:

- Identify actions to achieve goals,
- Estimate existing groundwater,
- Estimate groundwater being used,
- Determine recharge, and
- Project water demand.

In addition, the legislation required well permits. Today there are 16 groundwater management areas, with Region O and A covering most of the Texas Panhandle where many dairies have relocated. Their regional water management plans can be accessed at: www.cpa.state.tx.us/specialrpt/water/regionO.php , www.cpa.state.tx.us/specialrpt/water/regionA.php.

Both Region A and O Groundwater Management Areas have targeted conservation of existing groundwater supplies by irrigators. Recently, the North Plains Underground Conservation District (http://www.npwd.org/) in Region A took steps to force conservation by the enactment of pumping restrictions. As part of their Groundwater Management Plan to reduce water use over time, irrigation was restricted to 2 acre-ft/yr through December 31, 2010. Further restrictions to 1.75 acre-ft/yr in 2011 and 1.5 acre-ft/yr after Jan. 1, 2012 were adopted. As part of the process to monitor compliance, meters have been required on all non-exempt wells with annual reporting requirements.

In March, 2011 the High Plains Water District proposed changes to regulate water use to 1.25 acre-ft/yr per contiguously controlled acre. If the water level in the Ogallala Aquifer declined by ≥ 2 ft of the average saturated thickness, the District could designate an area as High Decline and further restrict pumping by 5 %/yr until the targeted decline was met. The Board also had recommended a moratorium on new well permits for the high decline areas. After conducting five public meetings within the district, the Board is reviewing their proposed revisions to their rules.

Following enactment of Senate Bill 1, Senate Bill 2 was passed by the 77th Legislature in 2001. This bill created the Texas Water Advisory Council (**TWAC**), established a funding framework for supporting future water projects, and created a Joint Committee on Water Resources to meet during State Legislative interim periods. The overall goal was to strengthen management of groundwater resources.

Most recently, Senate Bill 3 was passed by the 80th Legislature in 2007 and created an Environmental Flows Standards for river basins and established an Environmental Flows Advisory Group. The legislation was designed to protect in-stream flows and freshwater inflows to keep Texas rivers and coastal estuaries healthy. The state was divided into 11 regions with 7 water basins that feed the coastal estuaries. The Texas Commission on Environmental Quality has initiated a public rulemaking process with Bay/Basin Expert Science Teams and Stakeholder Committees. The TCEQ decision for the Brazos region, which includes Erath Co., Comanche Co., through Lubbock and up to Muleshoe, is due by September 2013. A date has not yet been set for the Cypress, Sulphur, Red and Canadian Basins, which have the rest of the dairy regions. For further information on this process visit: http://www.tceq.state.tx.us/permitting/water_supply/water_rights/eflows/group.html

## CURRENT WATER USE PATTERNS

The legislative initiatives have resulted in a number of studies being conducted by the various management areas and water conservation districts. Table 2 depicts the direct water use by sector in Region A and O. Irrigation uses the largest proportion of water with municipalities and all livestock a distant second and third. The livestock water does not include the water used to grow the crops consumed by the various species.

In the report regarding the *Desired Future Conditions* for the Ogallala Aquifer, the North Plains Groundwater Conservation District (2008) wrote that **"**Based on the accelerated drilling activity in Hartley County and to a lesser extent in Dallam, Sherman and Moore counties to service the growing dairy industry need, an increase in water need over the next decade may occur in the four western counties that exceed State Water Plan estimates."

**Table 2.** Texas High Plains direct water use by sector

| Water Use by Sector ( %) | | Livestock Water Use by Species Total 1.48 % | |
|---|---|---|---|
| Irrigation | 93.25 % | Fed cattle | 0.84 % |
| Municipal | 2.94 % | Other | 0.35 % |
| Livestock | 1.48 % | Dairy | 0.19 % |
| Manufacturing | 0.99 % | Swine | 0.10 % |
| Steam Electric | 0.84 % | | |
| Mining | 0.50 % | | |

[1]Other includes poultry, range cattle, equine, sheep and goats, and summer and winter range cattle.
[2]Source: Amosson et al., 2010.

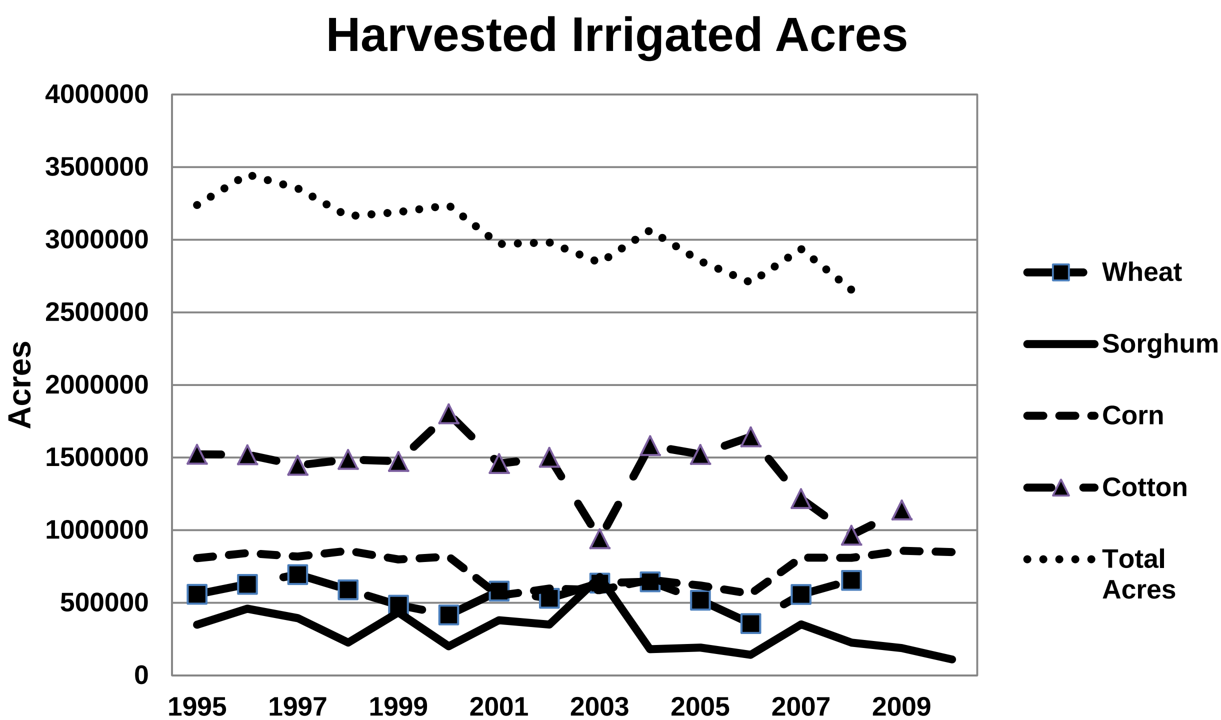


**Figure 1.** The total harvested irrigated acres in the 44 Texas Panhandle counties. Stonewall County is the southeast corner of those counties included (USDA-NASS, 2011a,b,c,d).

In an effort to evaluate the impact of over 200,000 dairy cows moving into the Panhandle during the last 10 yr, we compiled data from the USDA-NASS (2011a,b,c,d) database regarding irrigated cropping trends in the 44 counties of the Panhandle since 1995, 5 yr prior to the beginning of the influx of dairies into the region. The 44 counties include those lying west and north of Stonewall County in the Texas Panhandle. Total harvested wheat acreage was only available until 2008 and cotton was only available until 2009; while corn and sorghum data were available through the 2010 cropping season. Figure 1 illustrates how the total harvested irrigated acreage has tended to decline from 1995 to 2008. The corn acreage was depressed from 2001 to 2006, but in recent years is very similar to the 1995 to 2000 time frame.

Figure 2 graphs the price of corn and the number of dairy cows in the High Plains region based on data from the Dallas Milk Market Administrator. From this data it appears there may be a stronger relationship between the price of corn and the acres grown than the number of dairy cows entering the region.

Using Extension budget estimates of irrigation water requirements (defined subsequently), we estimated that the average irrigation water used from 1995 – 1997 was approximately 51,079,467 acre-in/yr in the 44 counties. As a result of the decline in acres harvested, irrigation water declined to 42,513,233 acre-in/yr from 2006 – 2008; a decline of over 8.5 million acre-in.

## WATER USE FOR DAIRIES

To calculate the mix of forages being used on Texas Panhandle dairies, dairy producers in the region from Select Milk Producers, a milk marketing cooperative, were sent a one page questionnaire regarding the forages they raised and purchased to feed the dairy cows and heifers in their herd. Surveys from 14 milking herds were returned.

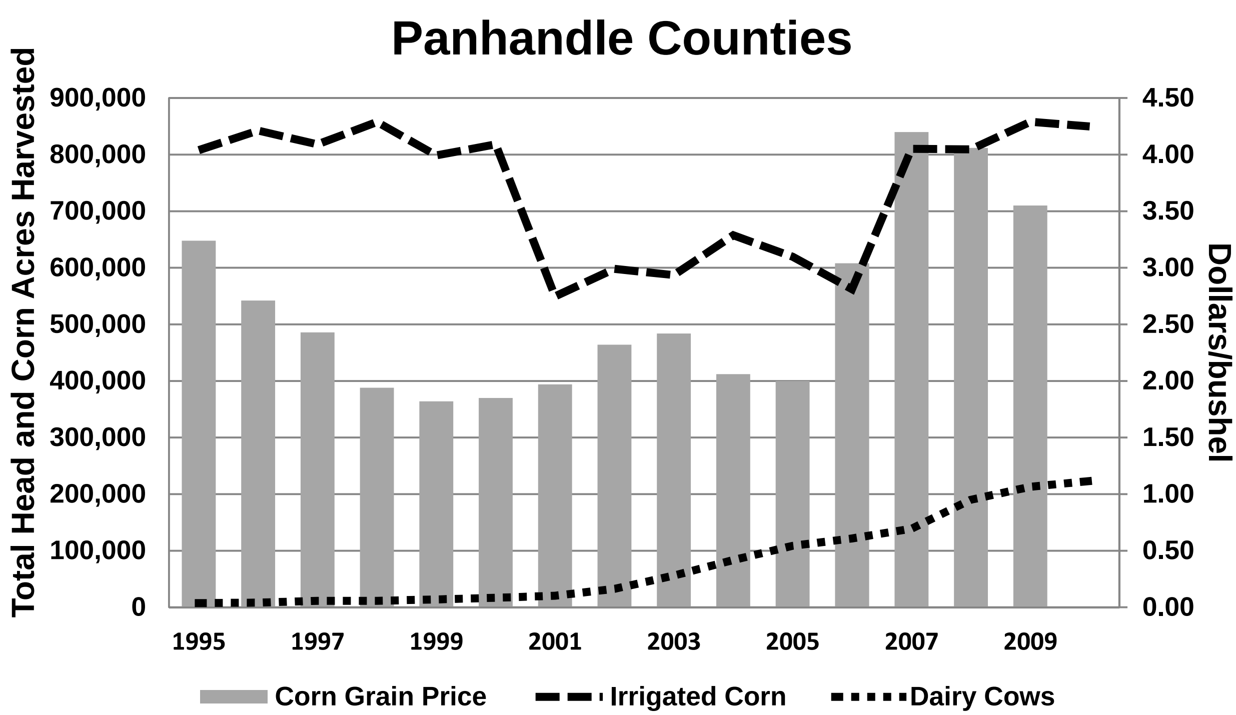


**Figure 2.** The number of milking cows, price of corn grain and the acres of corn grown in 44 counties in the Texas Panhandle from 1995 through 2009 or 2010 (USDA-NASS, 2011a; USDA-ERS, 2011; USDA-Milk Market Administrator, Federal Order 126, 1995-2010).

Two herds had heifer operations associated with them that raised heifers for other individuals. One heifer operation had separate feed inventories. In the second operation, 7000 heifers from 6-12 mo were fed from the combined feed inventory. Roughage consumption by the heifers in this operation was estimated and removed from the remaining calculations. Estimates below are calculated after these adjustments.

The mean number of animals utilized in estimations across herds was 7643 (SD 3169) with total acres owned by these herds to grow feed ranging from 0 to 5616. These herds averaged 86.4 % of the cows *in milk*, which is comparable to industry standards. In addition, 1488 bulls/steers were in the herds. No adjustment for the bulls/steers was made since many herds use bulls in various reproductive roles. Total forage DM on a *per milking cow* basis was 42.5 lb/d (36.7 lb/d if total cows). This value includes the dry land small grains produced as well as forages from outside the area. Total irrigated acreage within Texas averaged 0.907 acres per milking cow or 0.78 acres per cow (milking and dry). Approximately 10 % of the total acreage or roughly 39 % of the double cropped acreage required per cow was irrigated using water captured in the retention control structure. Table 3 displays the weighted average number of acres of forages raised by the producer or purchased locally needed to feed either one milking cow or one adult cow in Texas Panhandle herds for one year. The feed required for the associated young stock and bulls/steers is attributed to the milking cow or adult cow.

Each year, Extension creates budgets for the various cropping enterprises in the Panhandle, which include average irrigation requirements. Currently, the estimated average irrigation requirement for wheat is 15 acre-in; grain sorghum, 14 acre-in; sorghum silage, 13 acre-in; cotton, 12 acre-in; corn silage, 22 acre-in; corn grain, 22 acre-in; and alfalfa, 24 acre-in (Amosson, personal communication). Although sorghum silage is estimated to need 1 acre-in less water than grain sorghum, no adjustments are recommended for wheat and corn being grown for silages despite the fact that these crops are harvested earlier than their grain counterparts.

By using the forage utilization data from the survey of Lager et al. (2011), the average water use to support the forage production requirements per milking cow and her replacement can be estimated (Table 4). The 17.8 acre-in/yr for the crops used for dairy is < 5 % more irrigation water than the 16.9 acre-in/yr use in Texas estimated by Kenny et al. (2009).

**Table 3.** Acres per milking cow or per total cows required to raise forages being fed (CS=Corn Silage; SS=Sorghum Silage; SGS=Small Grain Silage). Adapted from Lager et al., 2011.

| | Mean | SE | Per Milking Cow and Replacement | Per Total Cows and Replacement |
|---|---|---|---|---|
| Irrigated Raised Forage, A | | | | |
| CS | 1155 | 258 | 0.31 | 0.268 |
| SS | 352 | 99 | 0.095 | 0.082 |
| SGS | 993 | 170 | 0.267 | 0.230 |
| Alfalfa | 357 | 124 | 0.096 | 0.083 |
| Of Raised Forage Land, A | | | | |
| Double Cropped Owned | 920 | 215 | 0.229 | 0.198 |
| Double Cropped, RCS Water | 390 | 108 | 0.09 | 0.078 |
| Irrigated Purchased Forage from Panhandle, A | | | | |
| CS | 425 | 170 | 0.09 | 0.078 |
| SS | 40 | 36 | 0.009 | 0.007 |
| SGS | 70 | 34 | 0.015 | 0.013 |

**Table 4.** Estimated average water use for crops to support the forage production for a milking cow and her replacement (CS=Corn Silage; SS=Sorghum Silage; SGS=Small Grain Silage).

| Crop | Acre/cow/yr to grow forage | Acre-in required by crop | Acre-in required |
|---|---|---|---|
| SGS | 0.28 | 14* | 3.9 |
| CS | 0.4 | 20* | 8.0 |
| SS | 0.1 | 13 | 1.2 |
| Alfalfa | 0.12 | 24 | 2.9 |
| Total | 0.90 | | 16.0Acre-in for 0.9 Acres or 17.8 Acre-in/Acre |

*Since the acre-in required for silage production requires at least one less watering based on personal communications the acre-in required was reduced from the Extension budgets by 1 in for SGS and 2 in for CS.

## POTENTIAL METHODS TO DECREASE WATER USE

In 2008, there were approximately 2.65 million irrigated acres in the 44 Panhandle counties for which data was obtained for Figure 1. Since there were 223,084 cows in the High Plains of Texas in May of 2010 (USDA-Milk Market Administrator, Federal Order 126, 1995-2010) requiring approximately 0.90 acres/cow/yr to grow the feed for her and her replacement, roughly 7.6 % of the irrigated acres in the Panhandle need to be dedicated to growing the dairy herd's forage requirements.

### Reduce alfalfa acreage

Since alfalfa has the largest irrigation water requirement of the forages being grown and it can be dried and transported greater distances as hay, producers in the Panhandle of Texas might explore purchasing their alfalfa needs from outside the region instead of growing their own crop. However, even if 100 % of the alfalfa hay currently being grown in the area were imported into the region instead, estimated average water use for the crops grown in the area for dairy would only fall to 16.8 acre-in/acre.

### Cease Double Cropping

The Table 4 estimate of the average water use for crops to support forage production assumed only one crop was grown on an acre per year. However, based on the survey results (Lager et al., 2011), 0.23 acre/cow/yr are double cropped. If the estimated water use is adjusted for double cropping, the irrigation water requirement could increase to over 25 acre-in/yr. This figure has not been adjusted for the 10 % of all acreage that is watered using effluent from the retention control structure or for the reduction in irrigation resulting from a reduced pre-watering requirement since a crop had recently been removed. Thus one realistic way to reduce the water use per acre is to cease double cropping.

There are additional factors which must be considered when making this decision. Many of the acres that are double cropped on dairies are actually being used to dewater retention control structures. Before arbitrarily stopping all double cropping the impact on nutrient flows must be computed. There is additional cost related for distributing the effluent over a more distant land base, as well as transportation costs to return necessary forages to the dairy. In some instances it may be more prudent to allow more remote acres to lie fallow and concentrate the growing of crops in close proximity to the dairy. Of course whether this is an option will depend upon how pumping regulations are written, the acreage controlled by an individual producer, and nutrient budgeting to optimize use of the organic matter produced on a dairy.

### Switch to More Sorghum

There has been a great deal of discussion regarding switching to sorghum silage from corn silage to reduce the irrigation water required for growing forages. Each year, Texas AgriLife Research and Extension scientists conduct trials to evaluate the various hybrids. In 2010, a total of 56 forage sorghum varieties, 16 conventional and 32 BMR, were included in the trials (Bean et al., 2010). The forage sorghums received approximately 12 in of irrigation water in addition to 7.3 in of rainfall. The nonBMR sorghums had 5.8 % lodging at harvest while the BMR sorghums had 17.8 % lodging. The sorghum forage was harvested at soft dough stage (Bean et al., 2010). Select data from the trial is included in Table 5.

**Table 5.** Select data from corn and sorghum silage variety trials conducted in 2010 (adapted from Bean et al., 2010; Xu et al., 2010) and calculation of tonnages per acre-in of water.

| Crop | T/Acre-in Irrigation + Rain, 35 % DM | T/Acre-in Irrigation, 35 % DM | T/ac @ 35 % DM | % CP | % ADF | % NDF | % IVTD | % Starch | Milk, lb/T DM |
|---|---|---|---|---|---|---|---|---|---|
| NonBMR Sorghum | 1.27 | 2.05 | 24.6 | 7.9 | 30.9 | 48.1 | 78.6 | 19.9 | 2,751 |
| BMR Sorghum | 1.20 | 1.92 | 23.1 | 8.1 | 29.6 | 46.8 | 81.5 | 16.9 | 2,917 |
| Corn Silage, Halfway | 1.18 | 2.07 | 30.3 | 9.0 | 21.3 | 36.6 | 78.7 | 40.9 | 2,999 |
| Corn Silage, Etter | 1.42 | 1.77 | 31.4 | 8.2 | 21.1 | 36.9 | 77.5 | 41.5 | 2,922 |

CP= crude protein; ADF=acid detergent fiber; NDF=neutral detergent fiber; IVTD= in vitro true digestibility; NDFD= %NDF digestible in 24 hr; Milk lb/t is a projection of potential milk yield/t;

Corn silage trials were conducted in 2 different locations in 2010 (Xu et al., 2010). At the Halfway, TX location, 14.58 acre-in of irrigation water was used in addition to the 11.03 in of rainfall. The silage was harvested at an average 50 % milk line and analyzed using NIR by the Dairy One Forage Lab (Ithaca, NY). At the Etter, TX location, 17.73 acre-in of irrigation water was used in addition to 4.38 in of rainfall. No pre-watering was done at either site since soil moisture profiles were adequate at planting. Average select data across all corn hybrids by location are presented in Table 5.

One must be careful when evaluating yield data per acre-in of irrigated water, as it is highly dependent upon soil moisture prior to planting and subsequent rainfall. Although the typical Panhandle Extension budgets for corn require 22 in of irrigation, neither site required that much in the 2010 corn silage variety trials; while the sorghum silages were within 1 in of the Extension budget irrigation quantity.

## Grow Genetically Modified Drought Resistant Crops

Texas AgriLife Research scientist Wenwei Xu has been crossing temperate and tropically adopted varieties of corn in an attempt to create new hybrids that can perform well with limited irrigation. Ledbetter (2008) reported that when 20 experimental hybrids were grown with 100 or 75 % evapotranspiration (**ET**) irrigation rates, yields averaged 27.49 and 26.84 T/acre, respectively. In addition, Xu et al. (2007) has reported that the drought resistant hybrids have reduced aflatoxin in some environments.

In addition to university research, many commercial companies have been seeking to identify corn that is drought tolerant. For example, this year Pioneer Hi-Bred (2010) has introduced its Optimum® AQUAmax™ hybrid line. Depending upon regulatory approvals, Monsanto (2011) is planning to begin on-farm field trials in 2012 and launch its first biotech product in 2013.

## Improve Efficiency of Irrigation

As illustrated in Table 1, irrigation application rates vary widely across the U.S. Although some of this is related to crop requirements, there are opportunities to enhance irrigation efficiencies to decrease the amount of water required to successfully grow crops. According to Benham (1998) conventional gated pipe irrigation has an efficiency of about 50 %, however by adding a reuse pit to the system the efficiency can increase to near 70 %. Another method to increase the efficiency is to irrigate using an every-other-furrow irrigation method which can reduce water requirements by 20 – 30 % (Benham, 1998). Most producers in the Texas panhandle have switched to center pivot systems, which Benham (1998) reported were 80 - 90 % efficient.

Schneider et al. (2001) compared 3 high efficiency irrigation methods: subsurface drip irrigation (**SDI**), low energy precision application (**LEPA**) and two spray irrigation methods – low elevation spray application (**LESA**) and mid-elevation spray application (**MESA**) on sorghum grain production. The crop was irrigated at 0, 25, 50, 75 or 100 % of the ET network recommendation. Although initial growing conditions were normal, the cumulative rainfall for the 4-mo growing season was only 49 % of the 60-yr average. The yields at the 25 and 50 % irrigation levels were significantly higher for the SDI; however at the 75 and 100 % levels, the LESA and MESA irrigation resulted in the highest yields leading the authors to conclude that for high efficiency irrigations methods optimal method may "vary more with the irrigation amount than with the application technology" (Schneider et al., 2001).

## CONCLUSION

As water resources become more limited, competition for those resources will increase. This will become particularly true for the dairy producers in the western portion of the United States that are more dependent upon groundwater to grow forages. Depending upon location, producers have several alternatives to how they can reduce their water usage for forage production. They can reduce the forages they grow and import those forages from another area, provided the forages are available and an economical alternative; switch to a forage with lower water demands, such as sorghum; leave more acres fallow; cease double-cropping; or switch to a higher efficiency irrigation method.

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