‘AN INTEGRATED APPROACH TO WATER CONSERVATION FOR AGRICULTURE IN THE TEXAS SOUTHERN HIGH PLAINS’

5th Annual Report

to the

Texas Water Development Board

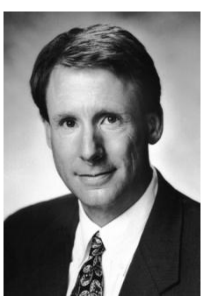
Texas Alliance For Water Conservation

TAWC

“Water is Our Future”

JUNE 30, 2010

Texas Alliance for Water Conservation participants:



Appreciation is expressed to
Senator Robert Duncan
and the
Texas Water Development Board

With their vision for the future of Texas and their passion for the protection of our Water Resources this project is made possible

The future of our region and our state depend on the protection and appropriate use of our water resources.

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WATER CONSERVATION DEMONSTRATION PRODUCER BOARD

Glenn Schur, Chair

Boyd Jackson, Co-Chair

Eddie Teeter, Secretary

Keith Phillips

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Jody Foster

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Louis (Bubba) Ehrlich

Rick Kellison (ex-officio), Project Director

The Producer Board of Directors is composed of producer representatives within the focus area of Hale and Floyd Counties and is specifically charged to:

1) Ensure the relevance of this demonstration project to meet its objectives;
2) Help translate the results into community action and awareness;
3) Ensure the credibility and appropriateness of work carried out under this project;
4) Assure compatibility with and sensitivity to producer needs and concerns; and
5) Participate in decisions regarding actions that directly impact producers.

The board elects their chair, chair-elect, and secretary. Individuals serving on this board include representation of, but are not limited to producers cooperating in specific demonstration sites. The Chair serves as a full voting member of the Management Team. The Project Manager serves in an *ex officio* capacity on the Producer Board. Meetings of the Producer Board of Directors are on an as need basis to carry out the responsibilities of the project and occur at least annually in conjunction with the overall Management Team.

The value of this board to the project continues to be a key factor in its success.

TEXAS ALLIANCE FOR WATER CONSERVATION PARTICIPANTS

Texas Tech University
Rick Kellison, Project Director*
Dr. Vivien Gore Allen*
Mr. Philip Brown
Dr. David Doerfert*
Dr. Phil Johnson*
Dr. Stephan Maas*
Dr. Eduardo Segarra*
Mr. Tom Sell*
Ms. Angela Beikmann,*
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Texas AgriLife Extension
Dr. Steven Klose*
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Mr. Jay Yates*

High Plains Underground Water Conservation District #1
Mr. Jim Conkwright*
Mr. Scott Orr*
Gerald Crenwelge

USDA - Natural Resource Conservation Service
Mr. Monty Dollar (retired)*

USDA – Agricultural Research Service
Dr. Ted Zobeck
Dr. Veronica Acosta-Martinez

Producer Board Chairman
Mr. Glenn Schur*

Post Doctoral Fellow
Dr. Nithya Rajan
Dr. Justin Weinheimer

Graduate Research Assistants
Rebekka Martin (completed 2005)
Pamela Miller (completed 2006)
Nithya Rajan (completed 2007)
Paul Braden (completed 2007)
Jurahee Jones (completed 2007)
Justin Weinheimer (completed 2008)
Katie Leigh (completed 2008)
Heather Jones (completed 2010)
Swetha Dorbala
Morgan Newsom
Jarrott Wilkinson
Rachel Oates
Song Cui
Yue Li
Cody Zilverberg

* Indicates Management Team member

'An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plains'

Background

The Texas High Plains currently generates a combined annual economic value of crops and livestock that exceeds $5.6 billion ($1.1 crops; $4.5 livestock; TASS, 2004) but is highly dependent on water from the Ogallala Aquifer. Ground water supplies are declining in this region (TWDB, 2007) while costs of energy required to pump water are escalating. Improved irrigation technologies including low energy precision application (LEPA) and sub-surface drip (SDI) irrigation have increased water use efficiencies to over 95% but have not always led to decreased water use. Furthermore, agriculture is changing in the Texas High Plains in response to a growing dairy industry and to current U.S. policy placing emphasis on renewable fuels, especially ethanol. Both the dairy and the ethanol industries are increasing demands for grain crops, primarily corn. Feeds demanded by the dairy industry also include corn for silage and alfalfa, both of which require irrigation at levels above the current major cropping systems in this region. Increasing grain prices, fertilizer costs, and uncertain energy costs are driving changes in this region as well as increasing water scarcity.

Diversified systems that include both crops and livestock have long been known for complimentary effects that increase productivity. Research conducted at Texas Tech over the past 10 years has shown that an integrated cotton/forage/beef cattle system, compared with a cotton monoculture, lowered irrigated water use by about 25%, increased profitability per unit of water invested, diversified income sources, reduced soil erosion, reduced nitrogen fertilizer use by about 40%, and decreased needs for other chemicals, while maintaining similar cotton yields per acre between the two systems (Allen et al., 2005; 2007; 2008). At cotton yields average for irrigated cotton in the region, profitability was greater for the integrated system than a cotton monoculture. Furthermore, soil health was improved, more carbon was sequestered, and soil microbial activities were higher in the integrated system compared with the cotton monoculture (Acosta-Martinez et al., 2004). This ongoing replicated research provided originally the information for designing the demonstration project and now provides the basis for interpretation of results from the demonstration project. Together, the demonstration sites coupled with the replicated research are providing a uniquely validated approach to discovery and implementation of solutions to preserving and protecting our water resource while offering viable agricultural solutions to the Texas High Plains and beyond.

No single technology will successfully address water conservation. Rather, the approach must be an integration of agricultural systems, best irrigation technologies, improved plant genetics, and management strategies that reduce water demand, optimize water use and value, and maintain an appropriate level of productivity and profitability. Water conservation must become both an individual goal and a community ethic. Educational programs are needed at all levels to raise awareness of the necessity for, the technology to accomplish, and the impact of water conservation on regional stability and economics. As state and global populations increase with an increasing demand for agricultural products, the future of the Texas High Plains, and indeed the State of Texas and the world depends on our ability to protect and appropriately use our water resources. Nowhere is there greater opportunity to demonstrate the implications of successfully meeting these challenges than in the High Plains of west Texas.

A multidisciplinary and multi-university/agency/producer team, coordinated though Texas Tech University, assembled during 2004 to address these issues. In September of 2004 the project *'An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plains'* was approved by the Texas Water Development Board and funding was received in February, 2005 to begin work on this demonstration project conducted in Hale and Floyd Counties. A producer Board of Directors was elected to oversee all aspects of this project. Initially, 26 producer sites were identified to represent 26 different 'points on a curve' that characterize and compare cropping and livestock grazing system monocultures with integrated cropping systems and integrated crop/livestock approaches to agriculture in this region. The purpose is to understand where and how water conservation can be achieved while maintaining acceptable levels of profitability.

OBJECTIVE

To conserve water in the Texas Southern High Plains while continuing agricultural activities that provide needed productivity and profitability for producers, communities, and the region.

REPORT OF THE FIRST FIVE YEARS

In the first year of any demonstration or research project, the data should be interpreted with caution. As systems are begun and data collection is initiated, there are also many factors that do not function as they will over more time when everything becomes a mature system with data gathering techniques well developed. For each added year of reporting, some data will be missing because there is only a partial years accounting or because some data are not yet complete. However, because each annual report updates and completes each previous year, the current year's annual report is the most correct and comprehensive accounting of results to date and will contain revisions and additions for the previous years.

Because this project uses existing farming systems that were already functioning at the beginning of the project, the startup time was minimized and even in the first year, interesting data emerged that had meaningful interpretations. These data become more robust and meaningful with each additional year's data.

A key strategy of this project is that all sites are producer owned and producer driven. The producers make all decisions about their agricultural practices, management strategies, and marketing decisions. Thus, practices and systems at any specific site are subject to change from year to year as producers strive to address changes in market opportunities, weather, commodity prices, and other factors that influence their decisions. This project allows us to measure, monitor, and document the effects of these decisions. As this project progresses, it is providing a valuable measure of changes in agricultural practices in this region and the information to interpret what is driving these changes.

Sites were picked originally by the Producer Board of Directors in response to the request for sites that would represent a range of practices from high input, intensive management systems to low input, less intensive practices. The sites represent a range from monoculture cropping practices, integrated cropping systems, integrated crop and livestock systems, and all forage/livestock systems. Irrigation practices include subsurface drip, center pivot, furrow, and dryland systems.

It is important to recognize that these data and their interpretations are based on certain assumptions. These assumptions are critical to being able to compare information across the different sites involved in this demonstration project. These assumptions are necessary to avoid differences that would be unique to a particular producer or site that have nothing to do with understanding how these systems function. Thus, we have adopted certain constants across all systems such as pumping depth of wells to avoid variables that do not influence system behavior but would bias economic results. This approach means that the economic data for an individual site are valid for comparisons of systems but do not represent the actual economic results of the specific location. Actual economic returns for each site are also being calculated and made available to the individual producer but are not a part of this report.

The assumptions necessary for system comparisons are elaborated below.

ASSUMPTIONS OF DATA COLLECTION AND INTERPRETATION

1. Although actual depth to water in wells located among the 26 sites varies, a pumping depth of 260 feet is assumed for all irrigation points. The actual depth to water influences costs and energy used to extract water but has nothing to do with the actual functions of the system to which this water is delivered. Thus, a uniform pumping depth is assumed.

2. All input costs and prices received for commodities sold are uniform and representative of the year and the region. Using an individual's actual costs for inputs would reflect the unique opportunities that an individual could have for purchasing in bulk or being unable to take advantage of such economies and would thus represent differences between individuals rather than the system. Likewise, prices received for commodities sold should represent the regional average to eliminate variation due to an individual's marketing skill.

3. Irrigation system costs are unique to the type of irrigation system. Therefore, annual fixed costs were calculated for each type of irrigation system taking into account the average cost of equipment and expected economic life.

4. Variable cost of irrigation across all systems was based on a center pivot system using electricity as the energy source. The estimated cost per acre inch includes the cost of energy, repair and maintenance cost, and labor cost. The primary source of variation in variable cost from year to year is due to changes in the unit cost of energy. In 2009, prices of electricity decreased compared with the previous two years, reflecting the decline in crude oil prices.

5. Mechanical tillage operations for each individual site were accounted for with the cost of each field operation being based on typical custom rates for the region. Using custom rates avoids the variations among sites in the types of equipment owned and operated by individuals.

ECONOMIC ASSUMPTIONS

1. Irrigation costs were based on a center pivot system using electricity as the energy source.

Table 1. Electricity irrigation cost parameters for 2005, 2006, 2007, 2008 and 2009.

	2005	2006	2007	2008	2009
Gallons per minute (gpm)	450	450	450	450	450
Pumping lift (feet)	260	250	252	254	256
Discharge Pressure (psi)	15	15	15	15	15
Pump efficiency (%)	60	60	60	60	60
Motor Efficiency (%)	88	88	88	88	88
Electricity Cost per kWh	$0.085	$0.09	$0.11	$0.14	$0.081
Cost of Electricity per Ac. In.	$4.02	$4.26	$5.06	$6.60	$3.78
Cost of Maintenance and Repairs per Ac. In.	$2.05	$2.07	$2.13	$2.45	$3.37
Cost of Labor per Ac. In.	$0.75	$0.75	$0.80	$0.90	$0.90
Total Cost per Ac. In.	$6.82	$7.08	$7.99	$9.95	$8.05

2. Commodity prices are reflective of the production year; however, prices were held constant across sites.

Table 2. Commodity prices for 2005, 2006, 2007, 2008 and 2009.

	2005	2006	2007	2008	2009
Cotton lint ($/lb)	$0.54	$0.56	$0.58	$0.55	$0.56
Cotton seed ($/ton)	$100.00	$135.00	$155.00	$225.00	$175.00
Grain Sorghum – Grain ($/cwt)	$3.85	$6.10	$5.96	$7.90	$6.48
Corn – Grain ($/bu)	$2.89	$3.00	$3.69	$5.71	$3.96
Corn – Food ($/bu)	$3.48	$3.55	$4.20	$7.02	$5.00
Wheat – Grain ($/bu)	$2.89	$4.28	$4.28	$7.85	$5.30
Sorghum Silage ($/ton)	$20.19	$18.00	$18.00	$25.00	$24.00
Corn Silage ($/ton)	$20.12	$22.50	$25.00	$25.00	$42.90
Wheat Silage ($/ton)	$18.63	$22.89	$22.89	$29.80	$26.59
Oat Silage ($/ton)	-	$17.00	$17.00	-	$14.58
Millet Seed ($/lb)	$0.17	$0.17	$0.22	$0.25	-
Sunflowers ($/lb)	$0.21	$0.21	$0.21	$0.29	$0.27
Alfalfa ($/ton)	$130.00	$150.00	$150.00	$160.00	$160.00
Hay ($/ton)	$60.00	$60.00	$60.00	$60.00	$60.00
WWB Dahl Hay ($/ton)	$65.00	$65.00	$90.00	$90.00	-
Hay Grazer ($/ton)	-	$110.00	$110.00	$70.00	$110.00
Sideoats Seed ($/lb)	-	-	$6.52	$6.52	$3.90
Sideoats Hay ($/ton)	-	-	$64.00	$64.00	$70.00

3. Fertilizer and chemical costs (herbicides, insecticides, growth regulators, and harvest aids) are reflective of the production year; however, prices were held constant across sites for the product and formulation.

4. Other variable and fixed costs are given for 2005 through 2009 in Table 3.

Table 3. Other variable and fixed costs for 2005, 2006, 2007, 2008 and 2009.

	2005	2006	2007	2008	2009
VARIABLE COSTS					
Boll weevil assessment: ($/ac)					
Irrigated cotton	$12.00	$12.00	$12.00	$1.50	$1.00
Dryland cotton	$6.00	$6.00	$6.00	$1.50	$1.00
Crop insurance ($/ac)					
Irrigated cotton	$17.25	$17.25	$17.25	$20.00	$20.00
Dryland cotton	$12.25	$12.25	$12.25	$12.25	$12.25
Irrigated corn	$15.00	$15.00	$15.00	$15.00	$15.00
Cotton harvest – strip and module ($/lint lb)	$0.08	$0.08	$0.08	$0.08	$0.08
Cotton ginning ($/cwt)	$1.95	$1.75	$1.75	$1.95	$1.95
Bags, Ties, & Classing ($/480 lb bale)	$17.50	$19.30	$17.50	$18.50	$18.50
FIXED COSTS					
Irrigation system:					
Center Pivot system	$33.60	$33.60	$33.60	$33.60	$33.60
Drip system	$75.00	$75.00	$75.00	$75.00	$75.00
Flood system	$25.00	$25.00	$25.00	$25.00	$25.00
Cash rent:					
Irrigated cotton, grain sorghum, sunflowers, grass, millet, and sorghum silage.	$45.00	$45.00	$45.00	$75.00	$75.00
Irrigated corn silage, corn grain, and alfalfa.	$75.00	$75.00	$75.00	$100.00	$100.00
Dryland cropland	$15.00	$15.00	$15.00	$25.00	$25.00

5. The custom tillage and harvest rates used for 2005 were based on rates reported in USDA-NASS, 2004 Texas Custom Rates Statistics, Bulletin 263, September 2005. The custom rates used for 2006 were 115% of the reported 2004 rates to reflect increased cost of operation due to rising fuel prices and other costs while 2007 rates were 120% of the 2006 rates. 2008 rates were calculated at 125% of 2007 due to a 25% rise in fuel prices. 2009 rates were unchanged from 2008, as fuel prices stabilized.

WEATHER DATA

2005

The 2005 growing season was close to ideal in terms of temperatures and timing of precipitation. The precipitation and temperatures for this area are presented in Figure 1 along with the long-term means for this region. While hail events occurred in these counties during 2005, none of the specific sites in this project were measurably affected by such adverse weather events. Year 1, 2005, also followed a year of abnormally high precipitation. Thus, the 2005 growing season likely was influenced by residual soil moisture.

Precipitation for 2005, presented in Table 4, is the actual mean of precipitation recorded at the 26 sites during 2005 but begins in March when the sites were identified and equipped. Precipitation for January and February are amounts recorded at Halfway, TX; the nearest monitoring site.

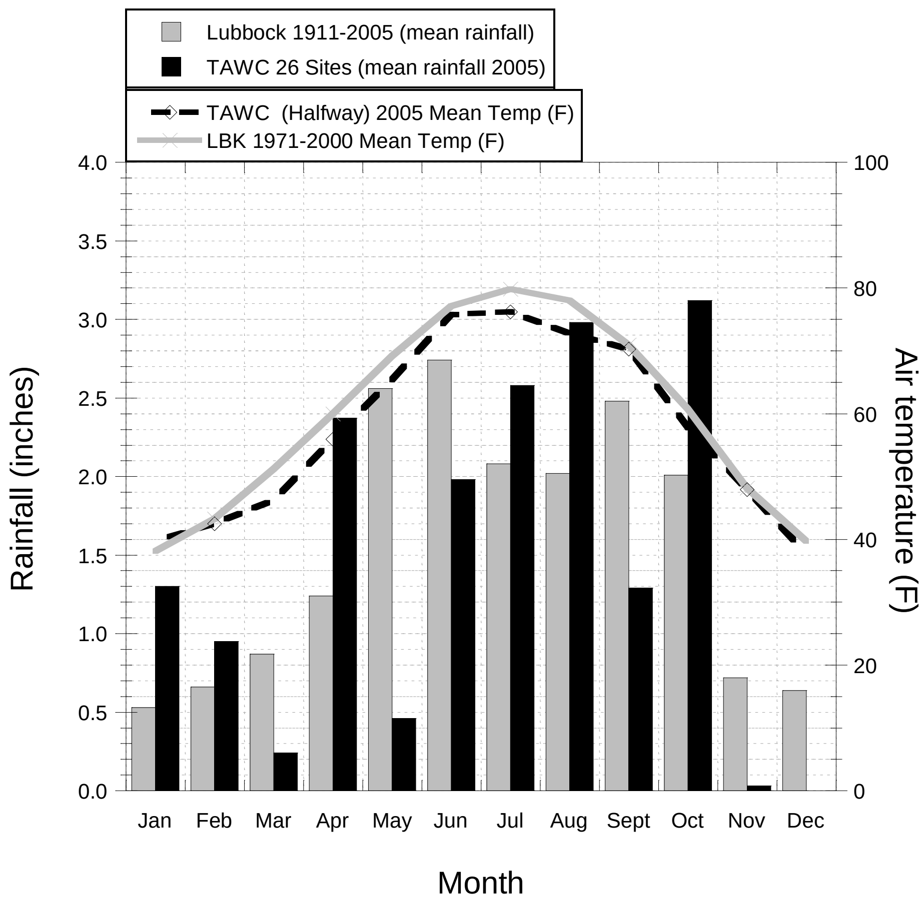

Figure 1. Temperature and precipitation for 2005 in the demonstration area compared with long term averages.

Table 4. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2005.

SITE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
01	0	0	0.4	1.3	0.2	1.7	2.2	2.4	2	4.1	0	0	14.3
02	0	0	0.4	1.8	0.5	1.4	2.4	3.6	0.8	3.4	0	0	14.3
03	0	0	0.7	2	0.6	1.4	2.5	4	0.4	3.2	0	0	14.8
04	0	0	0.6	8	0.3	1.4	2.2	3.2	0.1	1	0	0	16.8
05	0	0	0.6	2.9	0.4	1.5	3.2	4.2	0.6	1.7	0	0	15.1
06	0	0	0.5	1.5	0.4	3	2.4	1	2	4.2	0	0	15
07	0	0	0.5	1.5	0.6	2.6	2.4	1.5	3.3	3	0	0	15.4
08	0	0	0	1.5	0.6	2.6	2.4	1.5	3.3	3	0	0	14.9
09	0	0	0.5	1.5	0.5	2.6	2	1	3	3.3	0	0	14.4
10	0	0	0.4	1	0.2	2	1.8	1	1.6	3.1	0	0	11.1
11	0	0	0	1.2	0.4	3	2	1.7	1.8	4.3	0	0	14.4
12	0	0	0	0.7	0.4	3.2	2	2.2	1.2	2.8	0	0	12.5
13	0	0	0	1.7	0.4	3.4	3	2.6	1.2	4	0	0	16.3
14	0	0	0	1.3	0.5	1.8	3	2.2	2.2	3	0	0	14
15	0	0	0.4	1.3	0.5	2	3.6	4	2	5.4	0	0	19.2
16	0	0	0	1.4	0.4	2	3.2	3.4	1.8	4.1	0	0	16.3
17	0	0	0	2	0.5	2.2	3	3.6	1.6	4.6	0	0	17.5
18	0	0	0	4	0.9	1	2.8	4.8	0	3	0	0	16.5
19	0	0	0	3.2	0.5	1	2	4.6	0	2.6	0	0	13.9
20	0	0	0	2.8	0.4	1.6	3.4	4	0.8	2	0.4	0	15.4
21	0	0	0	1.2	0.6	2.5	2	2.5	2	4	0.3	0	15.1
22	0	0	0	5.8	0.3	1.6	2.6	4	0.2	0.6	0	0	15.1
23	0	0	0	3	0.3	1.2	2.9	3.6	0.5	0.9	0	0	12.4
24	0	0	0.8	4.8	0.3	1	2.9	4	0.4	0.8	0	0	15
25	0	0	0	2.3	0.9	2	2.4	3.4	0	7.4	0	0	18.4
26	0	0	0	2	0.4	1.7	2.8	3.4	0.7	1.7	0	0	12.7
Average	0.0	0.0	0.2	2.4	0.5	2.0	2.6	3.0	1.3	3.1	0.0	0.0	15.0

2006

The 2006 growing season was one of the hottest and driest seasons on record marked by the longest period of days with no measurable precipitation ever recorded for the Texas High Plains. Most dryland cotton was terminated. Rains came in late August and again in October delaying harvests in some cases. No significant hail damage was received within the demonstration sites.

Precipitation for 2006, presented in Figure 2 and Table 5, is the actual mean of precipitation recorded at the 26 sites during 2006 from January to December. The drought and high temperatures experienced during the 2006 growing season did influence system behavior and results. This emphasizes why it is crucial to continue this type of real-world demonstration and data collection over a number of years and sets of conditions.

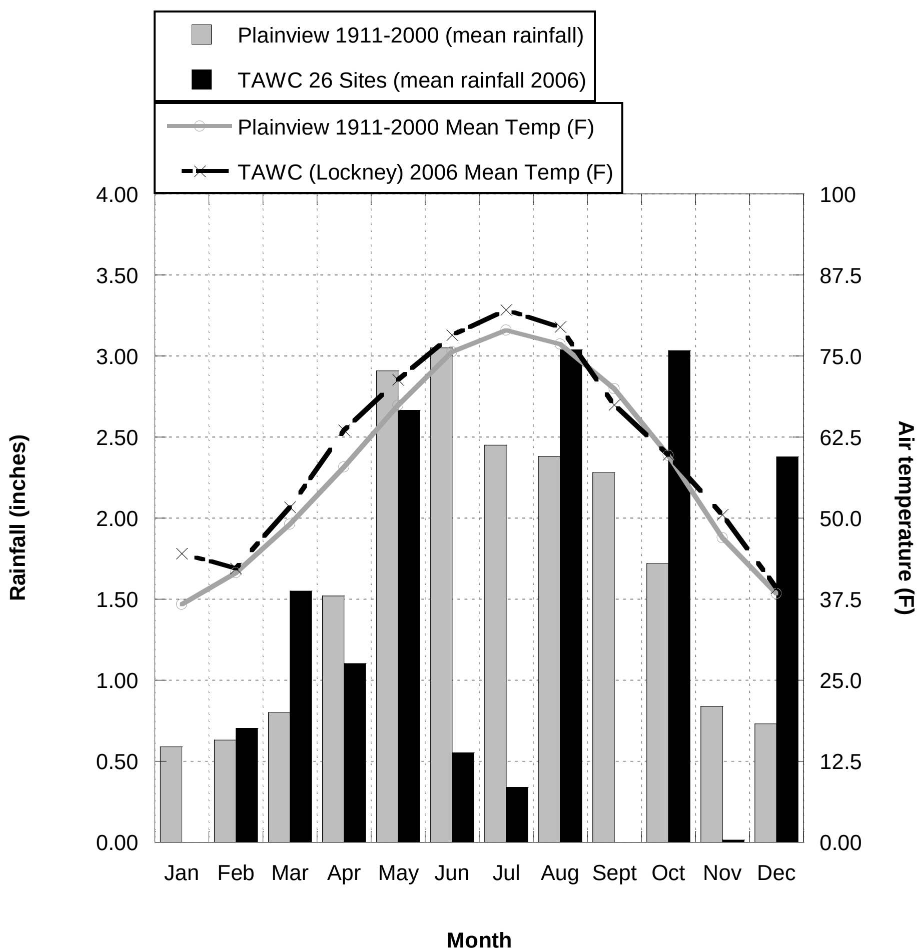

Figure 2. Temperature and precipitation for 2006 in the demonstration area compared with long term averages.

Table 5. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2006.

SITE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
01	0	0.9	1.7	1.2	2.6	0.5	0.55	2.3	0	2.87	0	2.6	15.22
02	0	0.8	1.9	1.1	1.9	0.2	0	2.6	0	3.05	0	1.8	13.35
03	0	0.6	1.5	0.9	2.6	0.7	0.22	3	0	3.14	0	3.2	15.86
04	0	0.5	1.4	1.1	2.7	0.2	0.4	3.8	0	2.56	0	2.8	15.46
05	0	0.7	1.4	1.8	3.2	0.4	0.57	4	0	2.78	0	2.8	17.65
06	0	0.7	1.5	0.8	3	0.4	0.2	5.4	0	2.6	0	2.7	17.3
07	0	0.5	1.3	0.9	1.92	0.5	0.33	3.8	0	2.75	0	2.1	14.1
08	0	0.5	1.3	0.9	1.92	0.5	0.33	3	0	2.75	0	2.1	13.3
09	0	0.6	1.5	0.8	1.82	0.5	0.12	3.8	0	3.28	0	2.4	14.82
10	0	0.6	1.5	1	3	0.4	0.11	3.1	0	2.8	0.1	2.4	15.01
11	0	0.5	0.7	0.4	2.5	0.4	0.1	3.5	0	3.3	0	1.6	13
12	0	0.8	1.4	0.8	2.2	0.9	0.2	1.9	0	3.3	0	2	13.5
13	0	1	1.8	0.8	2.2	1.1	0.1	2.7	0	3.05	0	1.8	14.55
14	0	0.8	1.8	1	2.8	0.3	0	1.6	0	3.8	0	2.6	14.7
15	0	1.4	2.2	1.4	2.8	0.4	0	2	0	4.4	0.1	2.6	17.3
16	0	1	2.2	1.3	2	0.8	0.2	2.6	0	2.69	0	2.2	14.99
17	0	0.8	2	1.3	2	1	0.3	3.3	0	3.38	0.1	3.2	17.38
18	0	0.7	1.2	1.2	1.8	1.1	0.74	2.6	0	3.11	0	3.6	16.05
19	0	0.6	1.3	1.1	1.3	1.4	0.75	1.2	0	3.11	0	2.3	13.06
20	0	0.6	1.4	1.3	3.8	0.4	0.55	4.07	0	2.56	0	2.2	16.88
21	0	0.9	2.6	1.4	2.8	0.4	0.73	2.2	0	3.54	0.1	2.7	17.37
22	0	0.6	1.5	1.3	3.8	0.3	0.22	1.8	0	2.66	0	1.9	14.08
23	0	0.4	0.9	1.1	3.8	0.2	0.55	3.6	0	3.7	0	2	16.25
24	0	0.5	1.6	1.2	4	0.7	0.12	2.8	0	2.64	0	2.3	15.86
26	0	0.7	1.3	1.3	3	0.3	0.86	4.3	0	2.49	0	1.7	15.95
27	0	0.6	1.4	1.3	3.8	0.4	0.55	4.07	0	2.56	0	2.2	16.88
Average	0.0	0.7	1.6	1.1	2.7	0.6	0.3	3.0	0.0	3.0	0.0	2.4	15.40

2007

Precipitation during 2007 totaled 27.2 inches (Table 6) and was well above the long-term mean (18.5 inches) for annual precipitation for this region. Furthermore, precipitation was generally well distributed over the growing season with early season rains providing needed moisture for crop establishment and early growth (Figure 3). Many producers took advantage of these rains and reduced irrigation until mid-season when rainfall declined. Growing conditions were excellent and there was little effect of damaging winds or hail at any of the sites. Temperatures were generally cooler than normal during the first half of the growing season but returned to normal levels by August. The lack of precipitation during October and November aided producers in harvesting crops.

Precipitation for 2007, presented in Figure 3 and Table 6, is the actual mean of precipitation recorded at the 26 sites during 2007 from January to December. Growing conditions during 2007 differed greatly from the hot dry weather encountered in 2006.

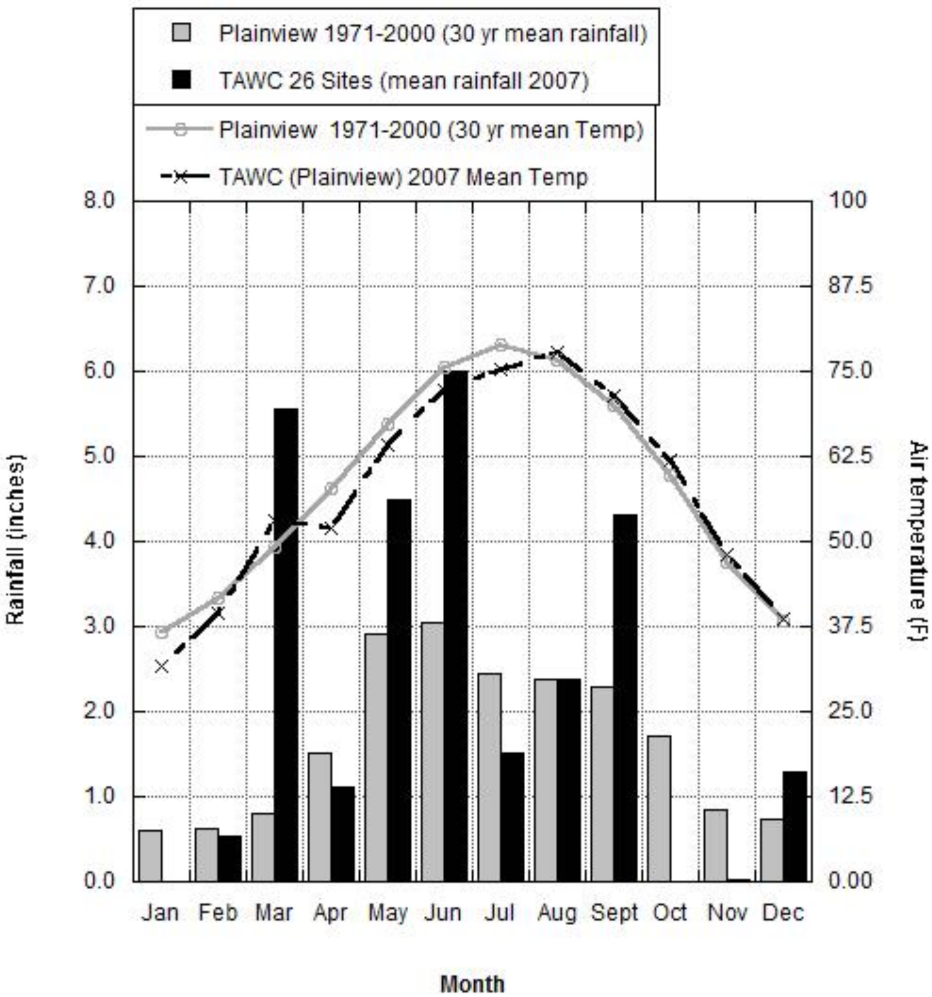

Figure 3. Temperature and precipitation for 2007 in the demonstration area compared with long term averages.

Table 6. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2007.

SITE	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
01	0	0.74	5.4	0.8	4.92	4.75	0.71	2.3	3.6	0	0	1.2	24.42
02	0	0.52	3.7	0.8	2.86	6.93	1.32	3	4.8	0	0	1.2	25.13
03	0	0.47	4.8	0.9	2.74	6.88	1.41	2.4	4.4	0	0	1	25
04	0	0.29	7.6	0.9	3.53	6.77	4	1.5	5	0	0	1	30.59
05	0	0.72	6	1.1	5.09	7.03	0.79	1.2	4.7	0	0	1.2	27.83
06	0	0.46	6	0.7	5.03	5.43	0.54	2	4.5	0	0	1.4	26.06
07	0	0.9	6.4	1	5.4	4.12	0.74	1.2	3.2	0	0	1.4	24.36
08	0	0.9	6.4	1	5.4	4.12	0.74	1.2	3.2	0	0	1.4	24.36
09	0	0.42	4.8	0.6	5.13	4.05	0.75	1.6	3	0	0	1	21.35
10	0	0.41	4.8	0.6	4.62	6.62	0.81	2.2	4.5	0	0	1.2	25.76
11	0	0.41	4.6	1.5	4.74	6.8	1.2	3.4	5.3	0	0	1	28.95
12	0	0.41	6.7	1.3	5.3	6.6	1.6	3	5.3	0	0	1	31.21
13	0	0.41	5.5	0.6	5	7.1	2	3	4	0	0	1.3	28.91
14	0	0.52	6.2	0.9	5.29	3.79	0.71	2.6	3.8	0	0	1.8	25.61
15	0	0.52	6.75	4	5.29	4.25	0.71	2.5	4	0	0	3	31.02
16	0	0.45	5	1	3.6	5.65	0.85	2.5	4.2	0	0	1	24.25
17	0	0.67	5.3	1	3.85	7.27	1.5	3.2	4.6	0	0	1.2	28.59
18	0	0.52	5.8	1.9	4.54	5.61	2.22	3	4	0	0	1.2	28.79
19	0	0.55	4	1	4.7	7.7	2.8	3.9	4.5	0	0	2	31.15
20	0	0.41	5.6	0.8	4.06	7.24	1.15	3	4.8	0	0	1	28.06
21	0	0.52	7.4	2	5.3	5.28	1.17	3.4	5.4	0	0	1.4	31.87
22	0	0.34	6.2	0.9	3.9	6.88	3.17	1.8	4	0	0	1	28.19
23	0	0.4	4.6	0.7	4.65	7.86	2.19	2	4.5	0	0	0.5	27.4
24	0	0.91	5.4	0.9	3.22	3.47	3.94	1.7	4.2	0	0	1.8	25.54
26	0	0.48	4	0.8	4.76	6.45	1.31	1	3.8	0	0	1.2	23.8
27	0	0.41	5.6	0.8	4.06	7.24	1.15	3	4.8	0	0	1	28.06
Average	0.0	0.5	5.6	1.1	4.5	6.0	1.5	2.4	4.3	0.0	0.0	1.3	27.2

2008

Precipitation during 2008, at 21.6 inches, was above average for the year (Table 7). However, the distribution of precipitation was unfavorable for most crops (Figure 4). Beginning the previous autumn, little rain fell until December and then less than an inch of precipitation was received before May of 2008. Four inches was received in May, well above the average for that month. This was followed by below average rain during most of the growing season for crops. In September and October, too late for some crops and interfering with harvest for others, rain was more than twice the normal amounts for this region. Following the October precipitation, no more rain came during the remainder of the year. This drying period helped with harvest of some crops but the region entered the winter with below normal moisture.

Temperatures during 2008 were close to the long-term mean for the region (Figure 4).

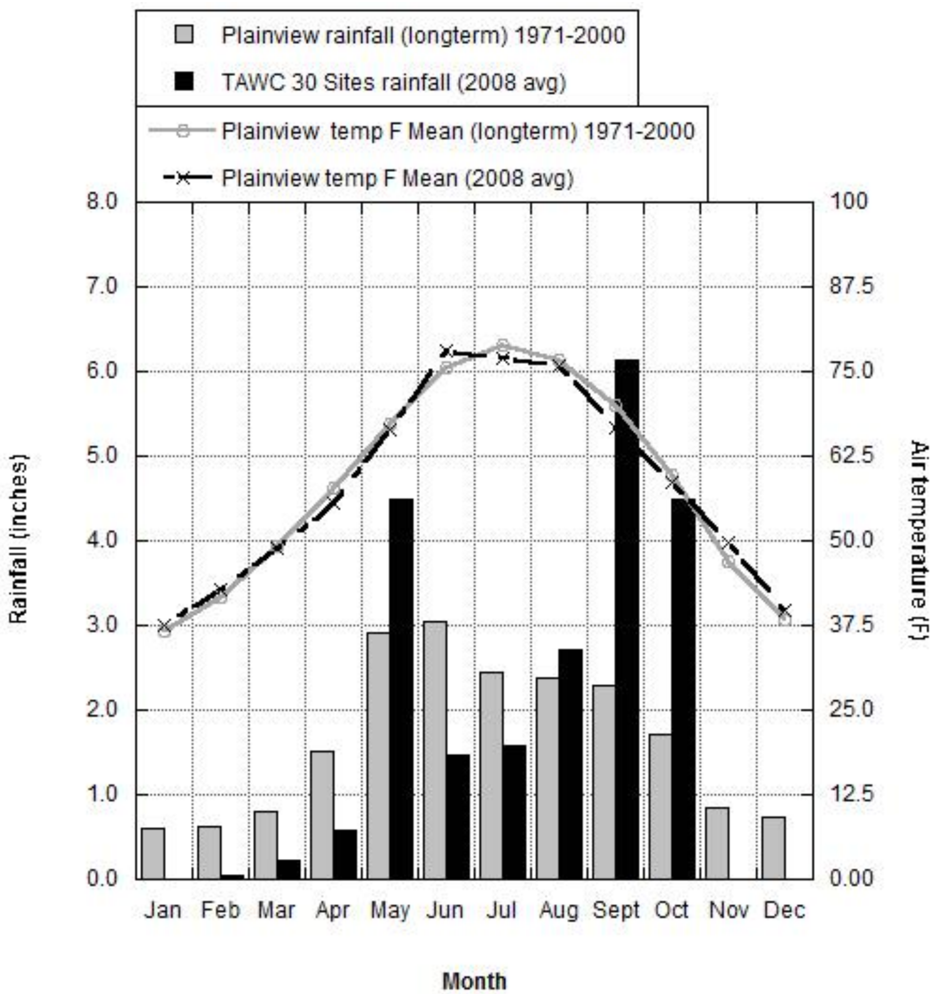

Figure 4. Temperature and precipitation for 2008 in the demonstration area compared with long term averages.

Table 7. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2008.

Site	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year Total
2	0	0	0.2	0.8	4.75	1.7	1	2.1	5.4	4.1	0	0	20.05
3	0	0	0.2	0.5	4.5	1.1	0.95	2	4.7	4.4	0	0	18.35
4	0	0	0.4	0.6	4	2.9	1.1	4.1	3	2.9	0	0	19
5	0	0	0	0.2	4	1.5	0.5	4.2	5	3.5	0	0	18.9
6	0	0	0.2	0.5	4.2	1.2	1.9	4	9.4	6	0	0	27.4
7	0	0	0	0.6	5.6	1.2	3.2	1.8	8.6	6.5	0	0	27.5
8	0	0	0	0.6	5.6	1.2	3.2	1.8	8.6	5.4	0	0	26.4
9	0	0	0	0.4	4.1	1	2.4	1.7	5.5	4	0	0	19.1
10	0	0	0	0.4	4.5	0.9	1	2.7	6.9	4.8	0	0	21.2
11	0	0	0.4	0.5	5.3	1.1	1.7	3.2	7.6	4.3	0	0	24.1
12	0	0	0.2	0.6	5	1.5	1.6	2.25	6.5	4.2	0	0	21.85
14	0	0.2	0.4	0.9	5	1.3	1.6	2.5	7.4	6	0	0	25.3
15	0	0.2	0.4	0.9	5	1.5	2.5	2.5	7.4	6	0	0	26.4
17	0	0	0.2	1.1	5	1.8	1.8	2.6	6.4	5.6	0	0	24.5
18	0	0.2	0.4	0.2	3.6	1.3	0.7	2.2	3	4	0	0	15.6
19	0	0.2	0.4	0.8	5	1	1.1	2.1	4.25	4.8	0	0	19.65
20	0	0	0.4	0.5	5	1.9	1.4	4.8	6.8	4.2	0	0	25
21	0	0.2	0.4	0.8	5	1.5	4	2.4	6	4.2	0	0	24.5
22	0	0	0.2	1	4.6	3	1.1	2.6	5	3.2	0	0	20.7
23	0	0	0.2	0.2	1.3	1.1	1	2.4	5.5	3.4	0	0	15.1
24	0	0	0.4	0.9	4.2	2.9	1.4	2.1	3.5	3	0	0	18.4
26	0	0	0.2	0.2	3.2	0.5	1.4	2.3	5.3	3.3	0	0	16.4
27	0	0	0.4	0.5	5	1.9	1.4	4.8	6.8	4.2	0	0	25
28	0	0	0	0.4	4.5	0.9	1	2.7	6.9	4.8	0	0	21.2
29	0	0	0	0.4	4	1	0.7	1.8	6.4	4.7	0	0	19
Average	0.00	0.04	0.22	0.58	4.48	1.48	1.59	2.71	6.07	4.46	0.00	0.00	21.62

2009

Precipitation during 2009 totaled 15.2 inches averaged across all sites. This was similar to precipitation in 2005, the first reporting year for this project. However, in 2005 above average winter moisture was received followed by precipitation in April that was nearly twice the long-term mean (Fig. 1; 2005). July, August, and October precipitation were also higher than normal in that year. In 2009, January began with very little precipitation that followed 2 months of no precipitation in the previous year (Fig. 4; 2008). Thus, the growing season began with limited soil moisture. March and May saw less than half of normal precipitation. While June and July were near of slightly above normal, August, September, October and November were all below normal. December precipitation was above normal and began a period of higher than normal moisture entering 2010.

Temperatures in February and March were above the long-term mean and peak summer temperatures were prolonged in 2009. However, by September, temperatures fell below normal creating a deficit in heat units needed to produce an optimum cotton crop.

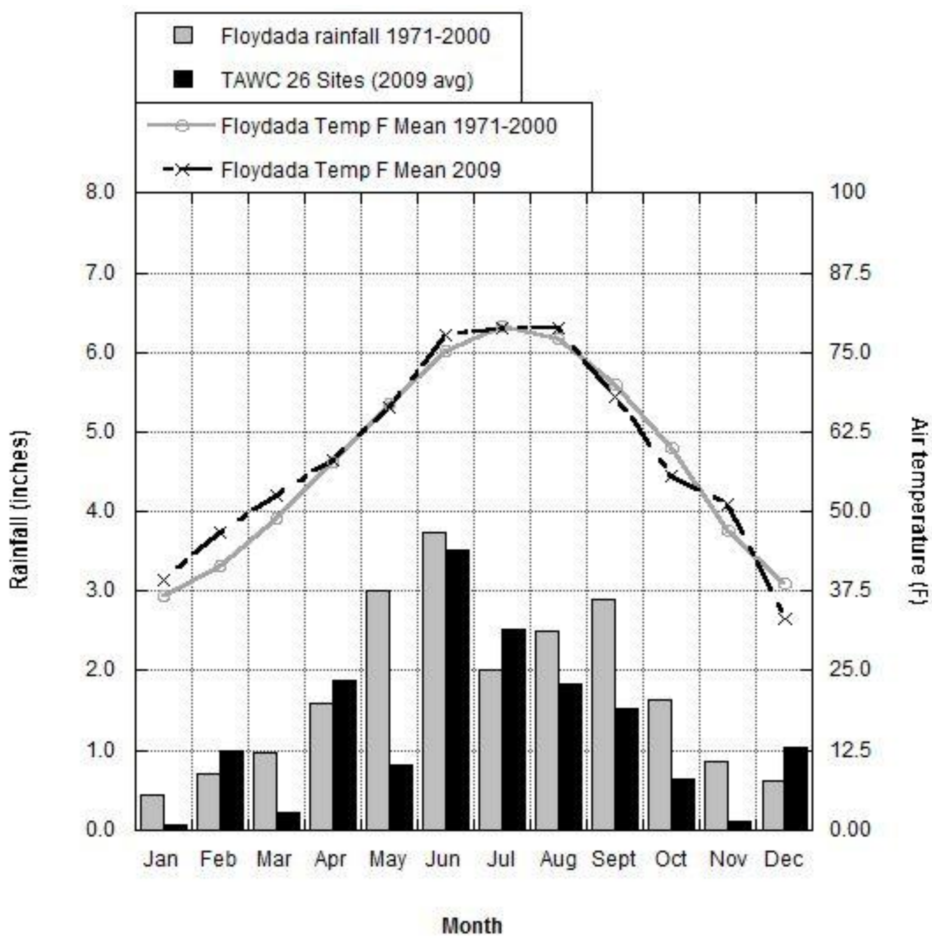

Figure 5. Temperature and precipitation for 2009 in the demonstration area compared with long term averages.

Table 8. Precipitation by each site in the Demonstration Project in Hale and Floyd Counties during 2009.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2	0.08	1.22	0.27	2.30	0.12	3.13	2.23	2.57	0.24	1.18	0.15	1.61	15.10
3	0.10	1.45	0.32	2.74	0.30	4.79	2.33	0.00	0.07	1.41	0.18	1.92	15.60
4	0.09	1.25	0.27	2.37	0.14	4.73	1.90	2.58	2.01	0.80	0.18	0.99	17.30
5	0.07	0.96	0.21	1.82	0.68	4.58	3.92	1.73	1.72	0.68	0.06	0.27	16.70
6	0.05	0.78	0.17	1.47	1.07	2.01	2.86	3.55	0.20	0.02	0.09	0.73	13.00
7	0.05	0.75	0.16	1.42	0.52	2.89	2.24	1.22	1.60	0.60	0.09	1.55	13.10
8	0.05	0.75	0.16	1.42	0.52	2.89	2.24	1.22	1.60	0.60	0.09	1.55	13.10
9	0.04	0.59	0.13	1.12	0.73	2.20	2.48	1.34	1.65	0.59	0.08	0.66	11.60
10	0.04	0.56	0.12	1.05	0.44	2.13	2.64	3.01	2.18	0.41	0.06	0.56	13.20
11	0.04	0.63	0.14	1.18	0.86	2.56	2.21	1.25	1.31	0.61	0.08	0.83	11.70
14	0.12	1.80	0.39	3.41	1.10	0.81	4.21	0.67	0.02	0.00	0.14	1.41	14.10
15	0.09	1.33	0.29	2.52	1.50	0.84	1.25	0.16	2.79	1.30	0.16	1.77	14.00
17	0.04	0.64	0.14	1.21	0.51	2.88	1.90	2.88	3.41	0.55	0.05	0.69	14.90
18	0.08	1.14	0.25	2.16	0.66	6.25	1.50	1.63	2.26	0.35	0.09	0.75	17.10
19	0.07	0.95	0.21	1.80	0.85	5.41	2.31	2.53	1.89	0.00	0.12	0.66	16.80
20	0.06	0.84	0.18	1.59	0.37	3.87	2.43	3.41	2.09	0.37	0.11	0.89	16.20
21	0.06	0.80	0.18	1.52	0.58	2.70	1.43	3.35	1.83	0.51	0.08	0.77	13.80
22	0.11	1.56	0.34	2.95	1.01	3.75	0.98	1.86	2.05	0.96	0.24	1.19	17.00
23	0.09	1.26	0.28	2.38	0.76	4.84	1.29	1.59	1.96	0.75	0.00	0.91	16.10
24	0.08	1.19	0.26	2.25	1.31	6.82	2.38	1.73	0.28	0.66	0.12	0.51	17.60
26	0.08	1.09	0.24	2.06	1.91	4.21	4.61	0.99	0.19	0.63	0.12	1.29	17.40
27	0.06	0.89	0.19	1.68	1.22	3.64	3.14	1.78	1.86	0.86	0.11	1.18	16.60
28	0.05	0.71	0.15	1.33	0.97	2.89	2.49	1.41	1.48	0.69	0.09	0.94	13.20
29	0.13	0.45	0.44	0.94	0.41	2.9	3.26	2.35	2.82	0.75	0.22	1.41	16.08
30	0.08	1.09	0.24	2.06	1.91	4.21	4.61	0.99	0.19	0.63	0.12	1.29	17.40
Average	0.07	0.99	0.23	1.87	0.82	3.52	2.51	1.83	1.51	0.64	0.11	1.05	15.15

Supplementary Grants to Project

2006

Allen, V. G., Song Cui, and P. Brown. 2006. Finding a Forage Legume that can Save Water and Energy and Provide Better Nutrition for Livestock in West Texas. High Plains Underground Water Conservation District No. 1. $10,000 (funded).

2007

Trostle, C.L., R. Kellison, L. Redmon, S. Bradbury. 2007. Adaptation, Productivity, & Water Use Efficiency of Warm-Season Perennial Grasses in the Texas High Plains. Texas Coalition, Grazing Lands Conservation Initiative, a program in which Texas State Natural Resource Conservation Service is a member. $3,500 (funded).

Li, Yue and V.G. Allen. 2007. Allelopathic effects of small grain cover crops on cotton plant growth and yields. USDA-SARE. Amount requested, $10,000 (funded).

Allen, V.G. and multiple co-authors. Crop-livestock systems for sustainable High Plains Agriculture. 2007. Submitted to the USDA-SARE program, Southeast Region, $200,000 (funded).

2008

Doerfert, D. L., Baker, M., & Akers, C. 2008. Developing Tomorrow's Water Conservation Researchers Today. Ogallala Aquifer Program Project. $28,000 (funded).

Doerfert, D.L., Meyers, Courtney. 2008. Encouraging Texas agriscience teachers to infuse water management and conservation-related topics into their local curriculum. Ogallala Aquifer Initiative. $61,720 (funded).

Request for Federal Funding through the Red Book initiatives of CASNR - $3.5 million. Received letters of support from Senator Robert Duncan, mayors of 3 cities in Hale and Floyd Counties, Glenn Schur, Curtis Griffith, Harry Hamilton, Mickey Black, and the Texas Department of Agriculture.

Prepared request for $10 million through the stimulus monies at the request of the CASNR Dean's office.

2009

Texas High Plains: A Candidate Site for Long-Term Agroecosystems Research. USDA-CSREES 'proof of concept' grant. $199,937 (funded).

Building a Sustainable Future for Agriculture. USDA-SARE planning grant, $15,000 (funded).

Maas, S., A. Kemanian, & J. Angerer. 2009. Pre-proposal was submitted to Texas AgriLife Research for funding research on irrigation scheduling to be conducted at the TAWC project site.

Maas, S., N. Rajan, A.C. Correa, & K. Rainwater. 2009. Proposal was submitted to USGS through TWRI to investigate possible water conservation through satellite-based irrigation scheduling.

Doerfert, D. 2009. Proposal was submitted to USDA ARS Ogallala Aquifer Initiative.

DONATIONS TO PROJECT

2005

City Bank, Lubbock, TX. 2003 GMC Yukon XL. Appraised value $16,500.

2008

July 31, 2008 Field Day sponsors:

Coffey Forage Seeds, Inc.	$500.00
Agricultural Workers Mutual Auto Insurance Co.	$250.00
City Bank	$250.00
Accent Engineering & Logistics, Inc.	$100.00
Bamert Seed Co.	$100.00
Floyd County Supply	$100.00
Plainview Ag Distributors, Inc.	$100.00
Production-Plus+	$100.00

Visitors to the Demonstration Project sites

2005

Total Number of Visitors	190

2006

Total Number of Visitors	282

2007

Total Number of Visitors	36

2008

Total Number of Visitors	53

2009

Total Number of Visitors	33+

AgriLife Extension personnel
William Asquith
Kelly Attebury
Terrell Bibb
Jennifer Blackburn
Thomas Christensen
Jim Bob Clary
Sarah Clifton
Miles Dabovich
Brice Foster
Keith Franks
Don Gohmert
Wayne Helbert
Aung K Hla
Dr. Wayne Hudnall
Bob Joseph
Hannah Lipps
Robert Mace
Carmon McCain
Tom McLemore
Gerald McMasters
Dave Mitamura
James Mitchell
Jack Moreman
Bill Mullican
Brent Oden
David Patterson
Bruce Rigler
Salvador Salinas
Quenna Terry
Cameron Turner
Brandt Underwood
Jon Weddle
C.E. Williams

PRESENTATIONS

2005

1-Mar	Radio interview (KRFE)	Allen
17-Mar	Radio interview	Kellison
17-May	Radio interview (KFLP)	Kellison
21-Jul	Presentation to Floyd County Ag Comm.	Kellison
17-Aug	Presentation to South Plains Association of Soil & Water Conservation Districts	Kellison
13-Sep	Presentation at Floyd County NRCS FY2006 EQIP meeting	Kellison
28-Sep	Presentation at Floyd County Ag Tour	Kellison/Trostle/Allen
20-Oct	Presentation to Houston Livestock and Rodeo group	Allen/Baker
3-Nov	Cotton Profitability Workshop	Pate/Yates
10-Nov	Presentation to Regional Water Planning Committee	Kellison
16-Nov	Television interview (KCBD)	Kellison
18-Nov	Presentation to CASNR Water Group	Kellison/Doerfert
1-Dec	Radio interview (KRFE)	Kellison
9-Dec	Radio interview (AgriTALK – nationally syndicated)	Kellison
15-Dec	Presentation at Olton Grain Coop Winter Agronomy meeting	Kellison

2006

Date	Presentation	Spokesperson(s)
24-26 Jan	Lubbock Southwest Farm & Ranch Classic	Kellison
7-Feb	Radio Interview	Kellison/Baker
2-Mar	South Plains Irrigation Management Workshop	Trostle/Kellison/Orr
30-Mar	Forage Conference	Kellison/Allen/Trostle
19-Apr	Floydada Rotary Club	Kellison
27-Apr	ICASALS Holden Lecture: "New Directions in Groundwater Management for the Texas High Plains"	Conkwright
15-Jun	Field Day @ New Deal Research Farm	Kellison/Allen/Cradduck/Doerfert
21-Jul	Summer Annual Forage Workshop	Trostle
27-Jul	National Organization of Professional Hispanic NRCS Employees annual training meeting, Orlando, FL	Cradduck (on behalf of Kellison)
11-Aug	2006 Hale County Field Day	Kellison
12-Sep	Texas Ag Industries Association Lubbock Regional Meeting	Doerfert (on behalf of Kellison)
11-Oct	TAWC Producer meeting	Kellison/Pate/Klose/Johnson
2-Nov	Texas Ag Industries Association Dumas Regional Meeting	Kellison
10-Nov	34th Annual Banker's Ag Credit Conference	Kellison
14-Nov	Interview w/Alphaeus Media	Kellison
28-Nov	Amarillo Farm & Ranch Show	Doerfert
8-Dec	2006 Olton Grain COOP Annual Agronomy Meeting	Kellison/Trostle
12-Dec	Swisher County Ag Day	Kellison/Yates
12-Dec	2006 Alfalfa and Forages Clinic, Colorado State University	Allen

2007

Date	Presentation	Spokesperson(s)
11-Jan	Management Team meeting (Dr. Jeff Jordan, Advisory Council in attendance)	
23-25 Jan	2007 Southwest Farm & Ranch Classic, Lubbock, TX	Kellison/Doerfert
6-Feb	Cow/Calf Beef Producer Meeting at Floyd County Unity Center	Allen
8-Feb	Management Team meeting	
13-Feb	Grower meeting, Clarendon, TX	Kellison
26-Feb	Silage workshop, Dimmitt, TX	
8-Mar	Management Team meeting	
21-Mar	Silage Workshop, Plainview, TX	Kellison/Trostle
22-Mar	Silage Workshop, Clovis, NM	Kellison/Trostle
30-Mar	Annual Report review meeting w/Comer Tuck, Lubbock, TX	
2-Apr	TAWC Producer meeting, Lockney, TX	
11-Apr	Texas Tech Cotton Economics Institute Research/Extension Symposium	Johnson
12-Apr	Management Team meeting	
21-Apr	State FFA Agricultural Communications Contest, Lubbock, TX (100 high school students)(mock press conf. based on TAWC info)	Johnson
7-May	The Lubbock Round Table meeting	Kellison
9-May	Area 7 FFA Convention, Texas State University, San Marcos, TX (distributed 200 DVD and info sheets)	Baker
10-May	Management Team meeting	
12-May	RoundTable meeting, Lubbock Club	Allen
15-17 May	Calibrating aerial imagery for estimating crop ground cover. 21st Biennial Workshop on Aerial Photog., Videography, and High Resolution Digital Imagery for Resource Assessment, Terre Haute, IN	Rajan
30-May	Rotary Club (about 100 present)	Allen
7-Jun	Lubbock Economic Development Association	Baker
14-Jun	Management Team meeting	
18-Jun	Meeting with Senator Robert Duncan	Kellison
10-Jul	Management Team meeting	
30 Jul – 3 Aug	Texas Vocational Agriculture Teachers' Association Annual Conference, Arlington, TX (distributed 100 DVDs)	Doerfert
9-Aug	Management Team meeting	
10-Aug	Texas South Plains Perennial Grass Workshop, Teeter Farm & Muncy Unity Center	Kellison/Trostle
13-15-Aug	International Symposium on Integrated Crop-Livestock Systems conference, Universidade Federal do Parana in Curitiba, Brazil	(Presentation made on behalf of Allen)

13-14-Aug	Comparison of water use among crops in the Texas High Plains estimated using remote sensing. 2007 Water Research Symposium, Socorro, NM	Rajan
14-17-Aug	Educational training of new doctoral students, Texas Tech campus, Lubbock, TX (distributed 17 DVDs)	Doerfert
23-Aug	Cattle Feeds and Mixing Program	
12-Sep	West Texas Ag Chem Conference	Kellison
18-Sep	Floyd County Farm Tour	Trostle
20-Sep	Management Team meeting	
1-Oct	Plant & Soil Science Departmental Seminar. "Overview and Initial Progress of the Texas Alliance for Water Conservation Project"	Kellison
8-Oct	Plant & Soil Science Departmental Seminar. "Estimating ground cover of field crops using multispectral medium, resolution satellite, and high resolution aerial imagery"	Rajan
11-Oct	Management Team meeting	
4-8 Nov	Using remote sensing and crop models to compare water use of cotton under different irrigation systems (poster). Accepted for presentation at the Annual Meetings, Amer. Soc. Agronomy. New Orleans, LA	Rajan
4-8 Nov	Assessing the crop water use of silage corn and forage sorghum using remote sensing and crop modeling. Accepted for presentation at the Annual Meetings, Amer. Soc. Agronomy. New Orleans, LA	Rajan
7-9-Nov	National Water Resources Association Annual Conference, Albuquerque, NM	Bruce Rigler (HPUWCD #1)
8-Nov	Management Team meeting (Comer Tuck in attendance)	
12-15-Nov	American Water Resources Association annual meeting, Albuquerque, NM (2 poster presentations)	Doerfert
16-Nov	Water Conservation Advisory Council meeting, Austin, TX	Allen
19-Nov	Plant & Soil Science Departmental Seminar. "Finding the legume species for West Texas which can improve forage quality and reduce water consumption"	Cui
27-29-Nov	Amarillo Farm Show, Amarillo, TX	Doerfert/Leigh/Kellison
2-4-Dec	Texas Water Summit, San Antonio, TX	Allen
13-Dec	Management Team meeting	

2008

Date	Presentation	Spokesperson(s)
4—7-Jan	Beltwide Cotton Conference Proceedings: *Energy Analysis of Cotton Production in the Southern High Plains of Texas*, Nashville, TN	Johnson/Weinheimer
10-Jan	Management Team meeting	
1-Feb	Southwest Farm and Ranch Classic, Lubbock	Kellison
14-Feb	Management Team meeting (Weinheimer presentation)	
14-Feb	TAWC Producer Board meeting	Kellison
5-Mar	Floydada Rotary Club	Kellison
13-Mar	Management Team meeting	
25-Mar	National SARE Conference: New American Farm Conference. "Systems Research in Action," Kansas City, MO	Allen
27-Mar	Media training for TAWC Producer Board	Doerfert/Kellison
Apr	Agricultural Economics Seminar: *Transitions in Agriculture*, Texas Tech University	Weinheimer
10-Apr	Management Team meeting	
5-May	Pasture and Forage Land Synthesis Workshop. "Integrated forage-livestock systems research," Beltsville, MD	Allen
8-May	Management Team meeting	
9-Jun	Walking tour of New Deal Research farm	Allen/Kellison/Li/Cui/Cradduck
10—12-Jun	Forage Training Seminar. "Agriculture and land use changes in the Texas High Plains," Cropland Genetics, Amarillo	Allen
12-Jun	Management Team meeting	
14-Jul	Ralls producers	Kellison
14-Jul	Water and the AgriScience Fair Teacher and Student Workshops	Kellison/Brown/Cradduck
15-Jul	Pioneer Hybrids Research Directors	Kellison
20—23-July	9th International Conference on Precision Agriculture, Denver, CO	Rajan
31-Jul	TAWC Field Day	all
8-Aug	TAWC Producer Board meeting	
12-Aug	Pioneer Hybrids Field Day	Kellison
9-Sep	Texas Ag Industries Association, Lubbock regional meeting	Allen
11-Sep	Management Team meeting	
16-Sep	Mark Long, TDA President, Ben Dora Dairies, Amherst, TX	Kellison/Trostle/ Cradduck
5—9-Oct	American Society of Agronomy Annual meeting, Houston	Rajan
8-Oct	American Society of Agronomy Annual meeting, Houston	Maas
15-Oct	State Energy Conservation Office (SECO) meeting	
16-Oct	Management Team meeting	

17-Oct	Thesis defense: *A Qualitative Investigation of the Factors that Influence Crop Planting and Water Management in West Texas*.	Leigh
20-Oct	Farming with Grass conference, Soil and Water Conservation Society, Oklahoma City, OK	Allen
23-Oct	Thesis defense: *Farm Level Financial Impacts of Water Policy on the Southern Ogallala Aquifer*	Weinheimer
13-Nov	Management Team meeting (Weinheimer presentation)	
17—20-Nov	American Water Resources Association, New Orleans (paper/posters presentations)	Doerfert/Leigh/ Newsom/Wilkinson/ Williams
19-Nov	TTU GIS Open House	Barbato
Dec	Panhandle Groundwater District: *Farm Level Financial Impacts of Water Policy on the Southern Ogallala Aquifer,* White Deer, TX	Johnson/Weinheimer
2—4-Dec	Amarillo Farm Show	Doerfert
3-Dec	Dr. Todd Bilby, Ellen Jordan, Nicholas Kenny, Dr. Amosson (discussion of water/crops/cattle), Amarillo	Kellison
6-Dec	Lubbock RoundTable	Kellison
6—7-Dec	Meeting regarding multi-institutional proposal to target a future USDA RFP on water management, Dallas	Doerfert
11-Dec	Management Team meeting	
12-Dec	Olton CO-OP Producer meeting	Kellison
19-Dec	TAWC Producer meeting	Kellison/Schur/ Cradduck/Weinheimer

2009

15-Jan	Management Team meeting	
21-Jan	Caprock Crop Conference	Kellison
27—29 -Jan	Southwest Farm & Ranch Classic (TAWC booth), Lubbock	Doerfert/Jones/Wilkinson/ Williams
27-Jan	Southwest Farm & Ranch Classic: *Managing Wheat for Grain*, Lubbock	Trostle
27-Jan	Southwest Farm & Ranch Classic: *2009 Planting Decisions – Grain Sorghum and Other Alternatives*, Lubbock	Trostle
28-Jan	Southwest Farm & Ranch Classic: *Profitability Workshop*, Lubbock	Yates/Pate
Feb	Floyd County crop meetings, Muncy	Trostle
Feb	Hale County crop meetings, Plainview	Trostle
12-Feb	Management Team meeting	
17-Feb	Crops Profitability workshops, AgriLife Extension and Research Center, Lubbock	Yates/Trostle
5-Mar	Crops Profitability workshops, AgriLife Extension and Research Center, Lubbock	Yates/Trostle
12-Mar	Management Team meeting	
1-Apr	Texas Tech Cotton Economics Institute Research Institutes 9th Annual Symposium (CERI): *Water Policy Impacts on High Plains Cropping Patterns and Representative Farm Performance*, Lubbock	Johnson/Weinheimer
9-Apr	Management Team meeting	
15-Apr	Texas Tech Forage Class	Kellison
21-Apr	Presentation to High Plains Underground Water District Board of Directors	Kellison
14-May	Management Team meeting	
27-May	Consortium for Irrigation Research and Education conference, Amarillo	Kellison
11-Jun	Management Team meeting	
22—24-Jun	Joint Meeting of the Western Society of Crop Science and Western Society of Soil Science: *Evaluation of the bare soil line from reflectance measurements on seven dissimilar soils* (poster presentation), Ft. Collins, CO	Rajan
26-Jun	Western Agricultural Economics Association: *Economics of State Level Water Conservation Goals*, Kauai, Hawaii	Weinheimer/Johnson
7-Jul	Universities Council of Water Resources: *Water Policy in the Southern High Plains: A Farm Level Analysis*, Chicago, IL	Weinheimer/Johnson
9-Jul	Management Team meeting	
27—31 –Jul	Texas Agriscience Educator Summer Conference, Lubbock	Doerfert/Jones
6-Aug	Management Team meeting	
17—19–Aug	TAWC NRCS/Congressional tour and presentations, Lubbock, New Deal & Muncy	TAWC participants
27-Aug	Panhandle Association of Soil and Water Conservation Districts	Kellison
10-Sep	Management Team meeting	
8-Oct	Management Team meeting	
9-Oct	Presentation to visiting group from Colombia, TTU campus, Lubbock	Kellison
13-Oct	Briscoe County Field day, Silverton, TX	Kellison

1—5-Nov	Annual Meetings of the American Society of Agronomy, oral presentations: *Evapotranspiration of Irrigated and Dryland Cotton Fields Determined Using Eddy Covariance and Penman-Monteith Methods,* and *Relation Between Soil Surface Resistance and Soil Surface Reflectance,* poster presentation: *Variable Rate Nitrogen Application in Cotton Using Commercially Available Satellite and Aircraft Imagery,"* Pittsburgh, PA	Maas/Rajan
10—12-Nov	Cotton Incorporated Precision Agriculture Workshop: *Biomass Indices*, Austin, TX	Rajan/Maas
12-Nov	Management Team meeting	
Dec	United Farm Industries Board of Directors: *Irrigated Agriculture,* Lubbock	Johnson/Weinheimer
1—3-Dec	Amarillo Farm Show, Amarillo	Doerfert/Jones/Oates/ Kellison
3-Dec	Management Team meeting	
10-Dec	TAWC Producer Board meeting, Lockney	Kellison/Weinheimer/Maas
14-Dec	Round Table meeting with Todd Staples, Lubbock, TX	Kellison
12—18 –Dec	Fall meeting, American Geophysical Union: *Vegetation cover mapping at multiple scales using MODIS, Landsat, RapidEye, and Aircraft imageries in the Texas High Plains,* San Francisco, CA	Rajan/Maas

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Rajan, N., and S. J. Maas. 2007. Comparison of water use among crops in the Texas High Plains estimated using remote sensing. Abstracts, 2007 Water Research Symposium, Socorro, NM.

Rajan, N., and S. J. Maas. 2007. Calibrating aerial imagery for estimating crop ground cover. In R. R. Jensen, P. W. Mausel, and P. J. Hardin (ed.) Proc., 21st Biennial Workshop on Aerial Photog., Videography, and High Resolution Digital Imagery for Resource Assessment, Terre Haute, IN. 15-17 May. 2007. ASPRS, Bethesda, MD.

Allen, V.G., D. Philipp, W. Cradduck, P. Brown, and R. Kellison. 2007. Water dynamics in integrated crop-livestock systems. Proc. Simpósio Internacional em Integraçâo Lavoura-Pecuâria. 13, 14, and 15 August, 2007. Curitiba, Parana, Brazil.

Acosta-Martínez, Verónica, Gloria Burow, Ted M. Zobeck, and Vivien Allen. 2007. Soil microbial diversity, structure and functioning under alternative systems compared to continuous cotton. Annual meeting of the American Society of Agronomy, New Orleans, LA. Nov. 4-8, 2007.

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Maas, S. J., and N. Rajan. 2008. Estimating ground cover of field crops using medium-resolution multispectral satellite imagery. Agronomy Journal 100(2), 320-327.

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Allen, V. G., C. P. Brown, R. Kellison, E. Segarra, T. Wheeler, P. A. Dotray, J. C. Conkwright, C. J. Green, and V. Acosta-Martinez. 2005. Integrating cotton and beef production to reduce water withdrawal from the Ogallala Aquifer. Agron. J. 97:556-567

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Martin, Rebekka. 2005. Economic evaluation of an integrated cropping system with cotton. M.S. Thesis, Texas Tech University, Lubbock.

Carr, Jessica Odette. 2007. An Examination of Rural Small Acreage Homeowners in Three West Texas Counties. M.S. Thesis, Texas Tech University, Lubbock.

Pauley, Patrick Stephen. 2007. Political and civic engagement of agriculture producers who operate in selected Idaho and Texas counties dependent on irrigation. Ph.D. Dissertation, Texas Tech University, Lubbock.

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Site Descriptions

Background

This project officially began with the announcement of the grant in September, 2004. However, it was February, 2005, before all of the contracts and budgets were finalized and actual field site selection could begin. By February, 2005, the Producer Board had been named and was functioning and the Management Team had been identified to expedite the decision-making process. Initial steps were taken immediately to advertise and identify individuals to hold the positions of Project Director and Secretary/Accountant. Both positions were filled by June of 2005. By autumn 2005, the FARM Assistance position was also filled.

Working through the Producer Board, 26 sites were identified that included 4,289 acres in Hale and Floyd Counties (Figure 6). Many of these sites were located in close proximity to soil moisture monitoring points maintained by the High Plains Underground Water Conservation District No. 1 (Figure 7). Personnel with the High Plains Underground Water Conservation District No. 1, under the direction of Scott Orr, began immediately to install and test the site monitoring equipment. This was completed during 2005 and was in place for most of the growing season.

Total number of acres devoted to each crop and livestock enterprise and management type in 2005, 2006, 2007, 2008 and 2009 are given in Tables 9, 10, 11, 12 and 13. These sites include subsurface drip, center pivot, and furrow irrigation as well as dryland examples. It is important to note when interpreting data from Year 1 (2005), that this was an incomplete year. We were fortunate that this project made use of already existing and operating systems; thus, there was no time delay in establishment of systems. Efforts were made to locate the information to fill gaps that occur due to the time it took to bring these 26 sites on-line but information in regard to water use is based on estimates as well as actual measurements during this first year and should be interpreted with caution. However, it provided useful information as we began this long-term project. It is also important to note that the first year of any project is unlikely to resemble closely any following year because of all the factors involved in start-up and calibration of measurement techniques. This is always the case. As we entered year 2, we were positioned to collect increasingly meaningful data and all sites were complete.

In year 2 (2006), Site No. 25 was lost to the project due to a change in ownership of the land. However, Site 27 was added, thus, the project continued to monitor 26 sites. Total acreage in 2006 was 4,230, a difference of about 60 acres between the two years. Crop and livestock enterprises on these sites and the acres committed to each use by site is given in Table 10.

In year 3 (2007), all sites present in 2006 remained in the project through 2007. Total acreage was 4,245, a slight increase over year 2 due to expansion of the area in Site No. 1.

In year 4 (2008), 25 sites included 3,967 acres (Table 12). Sites 1, 13, 16, and 25 of the original sites had left the project with sites 28 and 29 added since the project began.

In year 5 (2009), all sites present in 2008 remained in the project. Site 30 with 21.8 acres was added. Thus, 26 total sites were present in 2009 for a total of 3,991 acres in the project.

All numbers in this report continue to be checked and verified. THIS REPORT SHOULD BE CONSIDERED A DRAFT AND SUBJECT TO FURTHER REVISION. However, each year's annual report reflect completion and revisions made to previous year's reports as well as the inclusion of additional data from previous years. Thus, the most current annual report will contain the most complete and correct report from all previous years and is an overall summarization of the data to date.

The results of years 1-5 follow and are presented by site.

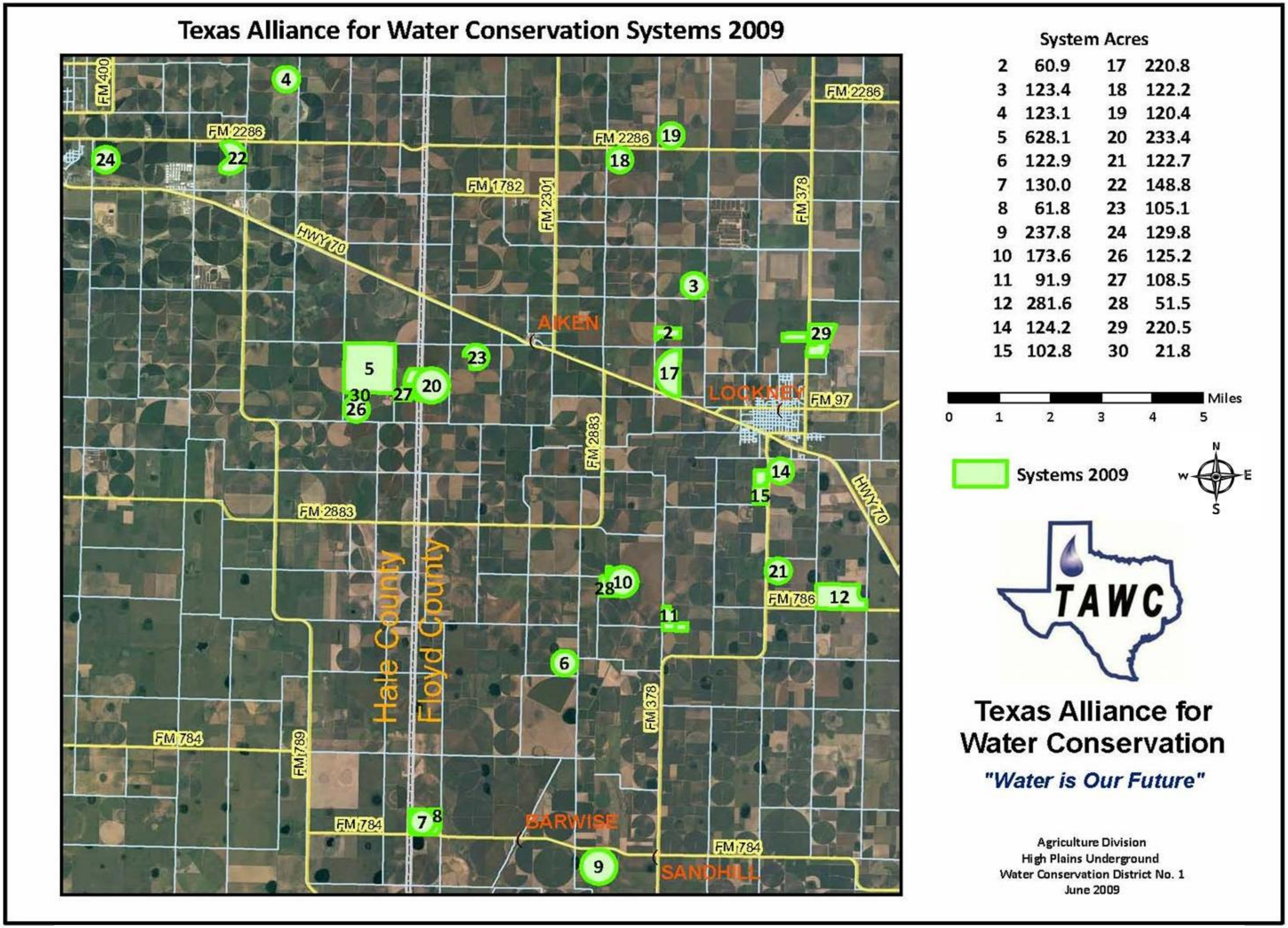


Figure 6. System map index for 2009 (Year 5).

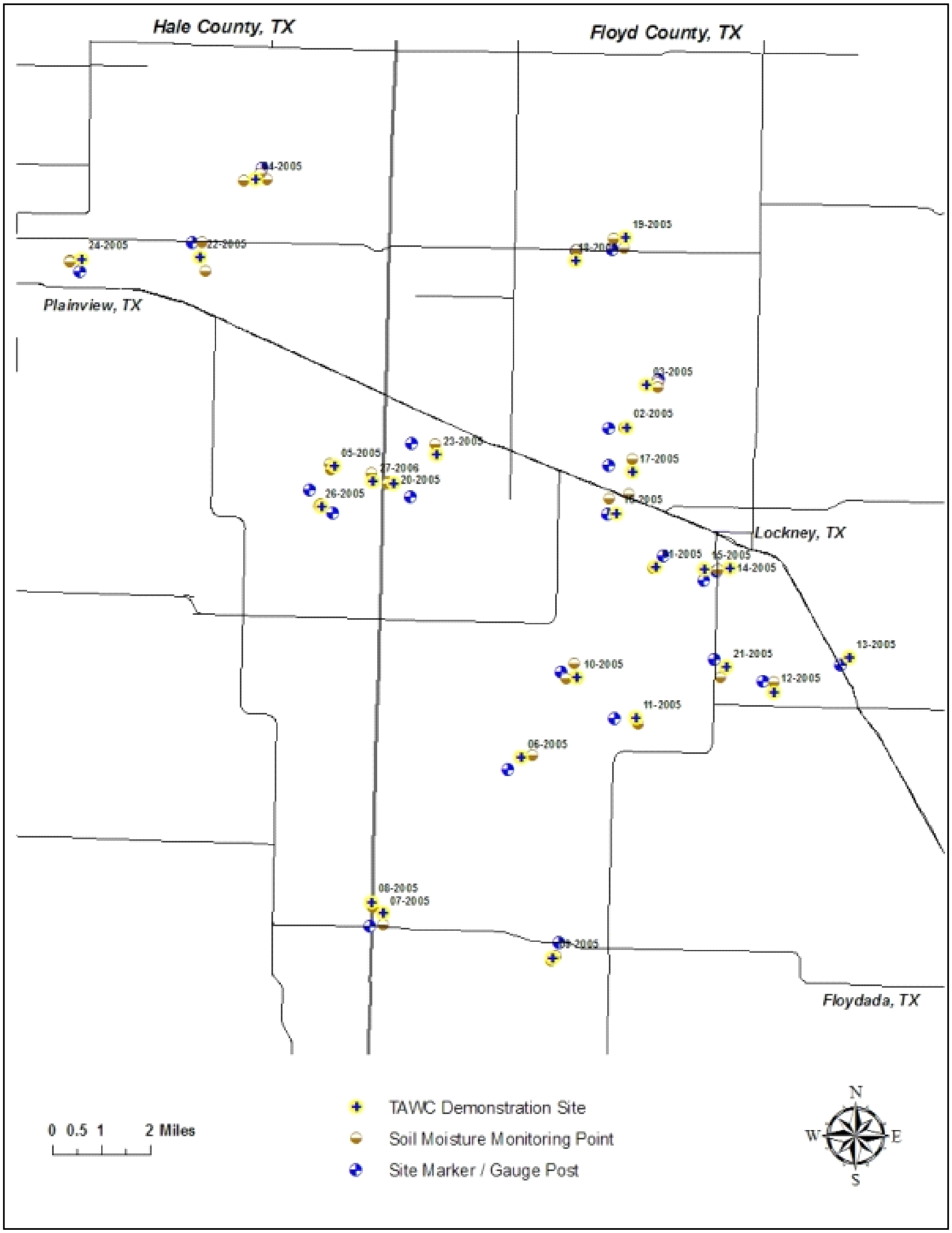


Figure 7. Location of soil moisture monitoring points in each of the 26 sites in the Demonstration project.

Table 9. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in 26 producer systems in Hale and Floyd Counties during 2005.

TAWC 2005 CROP ACRES - ACRES MAY OVERLAP DUE TO MULTIPLE CROPS PER YEAR AND GRAZING

Site	irrigation type	cotton	corn grain	corn silage	sorghum grain	sorghum forage	pearl millet	sunflowers	alfalfa	grass seed	perennial pasture	cattle	wheat	rye	triticale	oats
1	SDI	62.3														
2	SDI	60.9														
3	PIV	61.8			61.5											
4	PIV	109.8							13.3							
5	PIV/DRY								69.6		551.3	620.9				
6	PIV	122.9										122.9	122.9			
7	PIV									130.0						
8	SDI									61.8						
9	PIV	137.0									95.8	232.8		232.8		
10	PIV	44.5									129.1	129.1				
11	FUR	92.5														
12	DRY	151.2				132.7										
13	DRY	201.5											118.0			
14	PIV	124.2														
15	FUR	95.5														
16	PIV	143.1														
17	PIV	108.9		58.3							53.6					
18	PIV	61.5			60.7											
19	PIV	75.3					45.1									
20	PIV			115.8		117.6							117.6			
21	PIV	122.7														
22	PIV	72.7	76.0													
23	PIV	51.5						48.8								
24	PIV	64.7	65.1													
25	DRY	90.9			87.6											
26	PIV	62.9	62.3													
27	SDI	n/a														
Total 2005 acres		**2118.3**	**203.4**	**174.1**	**209.8**	**250.3**	**45.1**	**48.8**	**82.9**	**191.8**	**829.8**	**1105.7**	**358.5**	**232.8**	**0.0**	**0.0**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 10. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 26 producer systems in Hale and Floyd Counties during 2006.

TAWC 2006 CROP ACRES - ACRES MAY OVERLAP DUE TO MULTIPLE CROPS PER YEAR AND GRAZING

Site	irrigation type	cotton	corn grain	corn silage	sorghum grain	sorghum forage	pearl millet	sunflowers	alfalfa	grass seed	perennial pasture	cattle	wheat	rye	triticale	oats
1	SDI	135.2														
2	SDI	60.9														
3	PIV	123.3														
4	PIV	44.4				65.4			13.3				65.4			
5	PIV/DRY								69.6		551.3	620.9				
6	PIV	122.9														
7	PIV									130.0						
8	SDI									61.8						
9	PIV	137.0									95.8	95.8		137.0		
10	PIV					44.5					129.1	129.1				44.5
11	FUR	92.5														
12	DRY	132.7											151.2			
13	DRY	118.0											201.5			
14	PIV	124.2														
15	FUR	67.1			28.4											
16	PIV	143.1														
17	PIV	58.3		108.9							53.6	162.5	108.9			
18	PIV	60.7				61.2										61.2
19	PIV	75.1					45.3									
20	PIV			117.6		115.8									115.8	
21	PIV	61.3	61.4									61.3	61.3			
22	PIV	72.7	76													
23	PIV	51.5	48.8													
24	PIV	65.1		64.7												
25	DRY	n/a														
26	PIV	62.3	62.9													
27	SDI	46.2														
Total 2006 acres		**1854.5**	**249.1**	**291.2**	**28.4**	**286.9**	**45.3**	**0.0**	**82.9**	**191.8**	**829.8**	**1069.6**	**588.3**	**137.0**	**115.8**	**105.7**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 11. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 26 producer systems in Hale and Floyd Counties during 2007.

TAWC 2007 CROP ACRES - ACRES MAY OVERLAP DUE TO MULTIPLE CROPS PER YEAR AND GRAZING

Site	irrigation type	cotton	corn grain	corn silage	sorghum grain	sorghum forage	pearlmillet	sunflowers	alfalfa	grass seed	perennial pasture	cattle	wheat	rye	triticale	oats
1	SDI	135.2														
2	SDI	60.9														
3	PIV	61.5				61.8							61.8			
4	PIV	65.4							13.3			109.8	109.8			
5	PIV/DRY										620.9	620.9				
6	PIV	122.9														
7	PIV									130.0						
8	SDI									61.8						
9	PIV				137.0						95.8	95.8		232.8		
10	PIV			44.5							129.1	129.1				
11	FUR	92.5														
12	DRY	151.2			132.7											
13	DRY	201.5											118.0			
14	PIV	124.2														
15	FUR	66.7			28.8											
16	PIV	143.1														
17	PIV	108.9									167.2	167.2	108.9			
18	PIV				61.5								60.7			
19	PIV	75.8					45.6									
20	PIV			117.6		115.8									233.4	
21	PIV		61.3							61.4						
22	PIV	148.7														
23	PIV		105.2													
24	PIV		129.8													
25	DRY	n/a														
26	PIV		62.3				62.9					62.9				
27	SDI	16.2		46.2												
Total 2007 acres		**1574.7**	**358.6**	**208.3**	**360.0**	**177.6**	**108.5**	**0.0**	**13.3**	**253.2**	**1013.0**	**1185.7**	**459.2**	**232.8**	**233.4**	**0.0**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 12. Irrigation type and total acres, by site, of crops, forages and acres grazed by cattle in 26 producer systems in Hale and Floyd Counties during 2008.

TAWC 2008 CROP ACRES - ACRES OFTEN OVERLAP DUE TO MULTIPLE CROPS PER YEAR, GRAZING, AND OVERLAPPING CATEGORIES.																					
Site	**irrigation type**	**total acres (no overlap)**	**cotton**	**corn grain**	**sunflowers**	**grain sorghum**	**grain sorghum for seed**	**grain sorghum for silage**	**forage sorghum for hay**	**pearl millet for seed**	**alfalfa**	**grass seed**	**hay**	**perennial pasture**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**grazing of crop residue**	**barley for seed**	**fallow or pens/facilities**
2	SDI	60.9			60.9																
3	PIV	123.3	61.8			61.5										61.5					
4	PIV	123.1				65.4					13.3		13.3	13.3	44.4	44.4		44.4			
5	PIV/DRY	628.0											81.2	620.9	620.9						5.5
6	PIV	122.9	92.9	30.0																	
7	PIV	130.0										130.0	130.0	130.0							
8	SDI	61.8										61.8	61.8	61.8							
9	PIV	237.8	137.0											95.8	95.8						5.0
10	PIV	173.6		44.5									42.7	129.1	129.1	44.5					
11	FUR	92.5	47.3			45.2															
12	DRY	283.9						151.2													132.7
14	PIV	124.2	124.2																		
15	FUR	95.5	67.1													28.4					
17	PIV	220.8		108.9								111.9		111.9	220.8				108.9		
18	PIV	122.2	61.5			60.7											60.7				
19	PIV	120.4	75.0							45.4											
20	PIV	233.4				117.6		115.8					117.6			233.4					
21	PIV	122.7							61.3			61.4	122.7	61.4						61.3	
22	PIV	148.7		148.7																	
23	PIV	105.1	60.5		44.6																
24	PIV	129.8		129.8																	
26	PIV	125.2		40.4			22.5			62.3					125.2				125.2		
27	SDI	108.5	46.2	62.3																	
28	SDI	51.5		51.5																	
29	DRY	221.6	117.3												104.3			104.3			
Total 2008 acres		**3967.4**	**890.8**	**616.1**	**105.5**	**350.4**	**22.5**	**267.0**	**61.3**	**107.7**	**13.3**	**365.1**	**569.3**	**1224.2**	**1340.5**	**412.2**	**60.7**	**148.7**	**234.1**	**61.3**	**143.2**
# of sites		**25**	**11**	**8**	**2**	**5**	**1**	**2**	**1**	**2**	**1**	**4**	**7**	**8**	**7**	**5**	**1**	**2**	**2**	**1**	**3**
Site	**irrigation type**	**total acres (no overlap)**	**cotton**	**corn grain**	**sunflowers**	**grain sorghum**	**grain sorghum for seed**	**grain sorghum for silage**	**forage sorghum for hay**	**pearl millet for seed**	**alfalfa**	**grass seed**	**hay**	**perennial pasture**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**grazing of crop residue**	**barley for seed**	**fallow or pens/facilities**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

Table 13. Irrigation type and total acres, by site, of crops, forages, and acres grazed by cattle in producer systems in Hale and Floyd Counties during 2009.

TAWC 2009 CROP ACRES - ACRES OFTEN OVERLAP DUE TO MULTIPLE CROPS PER YEAR, GRAZING, AND OVERLAPPING CATEGORIES.																				
Site	**irrigation type**	**System acres**	**cotton**	**corn grain**	**Corn silage**	**sunflowers**	**grain sorghum**	**grain sorghum for silage**	**forage sorghum for hay**	**alfalfa**	**grass seed**	**hay**	**perennial pasture**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**grazing of crop residue**	**Oat silage**	**fallow or pens/facilities**
2	SDI	60.9	60.9																	
3	PIV	123.3	61.8				61.5													
4	PIV	123.1	13.3				28.4			16.0			16.0	98.3	65.4			98.3		
5	PIV/DRY	626.4										89.2	620.9	620.9						5.5
6	PIV	122.9	90.8	32.1																
7	PIV	129.9									129.9	129.9	129.9							
8	SDI	61.8									61.8	61.8	61.8							
9	PIV	237.8	137.0										100.8	100.8						
10	PIV	173.6	44.5										129.1	129.1						
11	FUR	92.5	68.1				24.4													
12	DRY	283.9						151.2												132.7
14	PIV	124.2	61.8												62.4					
15	FUR/SDI	102.8	102.8																	
17	PIV	220.8				108.9					53.6		111.9	111.9						
18	PIV	122.2	60.7												61.5					
19	PIV	120.3	60.2												60.1					
20	PIV	233.3	117.6		115.7															
21	PIV	122.6							61.2		61.4	61.4	61.4		61.2					
22	PIV	148.7	148.7																	
23	PIV	101.4						101.4								60.5			40.9	
24	PIV	129.7		64.6		65.1														
26	PIV	125.2		62.3		62.9								62.9			62.9			
27	SDI	108.5	48.8	59.7																
28	SDI	51.5	51.5																	
29	DRY	221.7	116.4												104.3					
30	PIV	21.8				21.8														
Total 2009 acres		**3990.8**	**1244.9**	**218.7**	**115.7**	**258.7**	**114.3**	**252.6**	**61.2**	**16.0**	**306.7**	**342.3**	**1231.8**	**1123.9**	**414.9**	**60.5**	**62.9**	**98.3**	**40.9**	**138.2**
# of sites		**26**	**16**	**4**	**1**	**4**	**3**	**2**	**1**	**1**	**4**	**4**	**8**	**6**	**6**	**1**	**1**	**1**	**1**	**2**
Site	**irrigation type**	**total acres (no overlap)**	**cotton**	**corn grain**	**Corn silage**	**sunflowers**	**grain sorghum**	**grain sorghum for silage**	**forage sorghum for hay**	**alfalfa**	**grass seed**	**hay**	**perennial pasture**	**cattle**	**wheat for grain**	**wheat for silage**	**wheat for grazing**	**grazing of crop residue**	**Oat silage**	**fallow or pens/facilities**

PIV = pivot irrigation SDI = subsurface drip irrigation FUR = furrow irrigation DRY = dryland, no irrigation

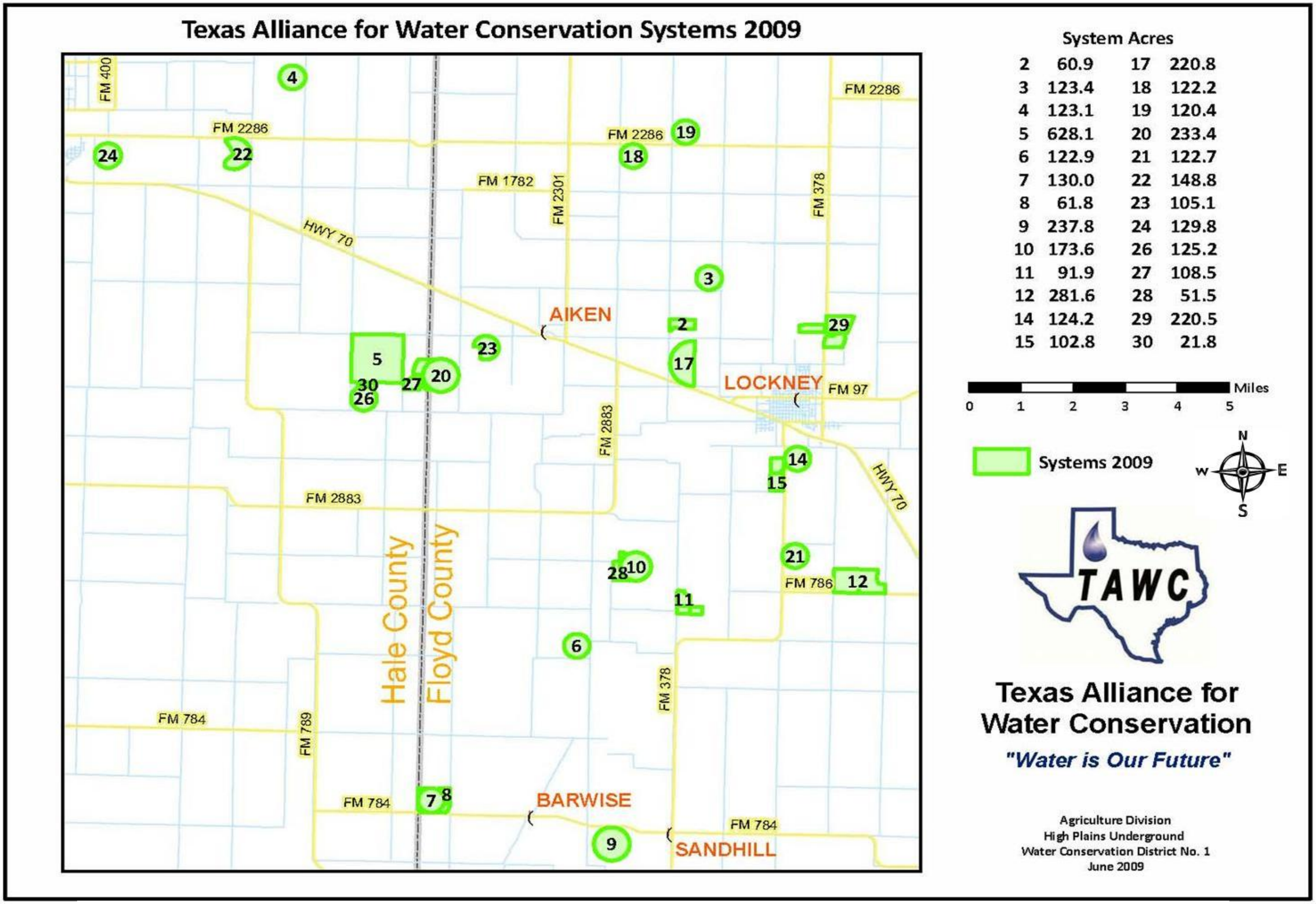
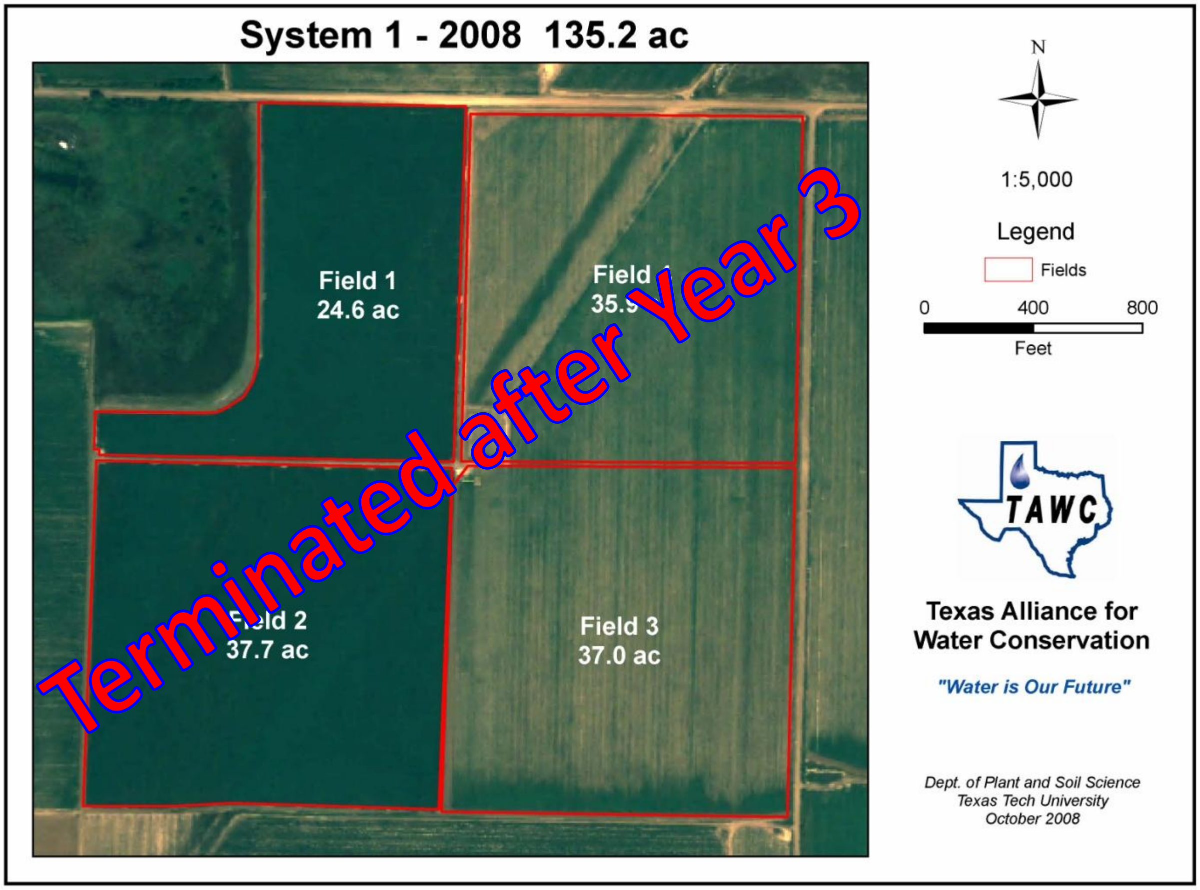


Figure 8. Systems map for 2009.



System 1 Description

Total system acres: 135.2

Field No. 1 Acres: 24.6
Major soil type: Estacado clay loam; 1 to 3% slope

Field No. 2 Acres: 37.7
Major soil type: Lofton clay loam, 0 to 1% slope
Pullman clay loam, 1 to 3% slope

Field No. 3 Acres: 37.0
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 4 Acres: 35.9
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Sub-surface Drip (SDI)
(Field 1 and 2 installed prior to 2004 crop year)
(Field 3 and 4 installed prior to 2006 crop year)

Pumping capacity, gal/min: 850

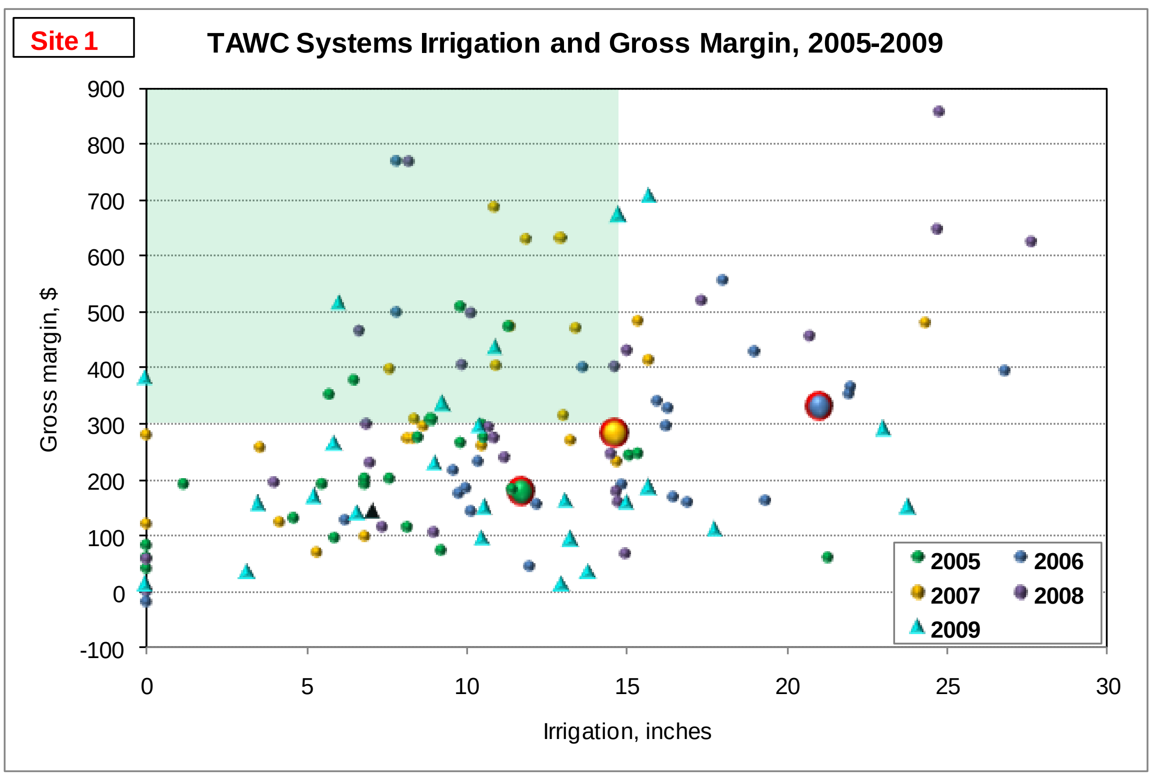
Number of wells: 2

Fuel source: Electric
Natural gas

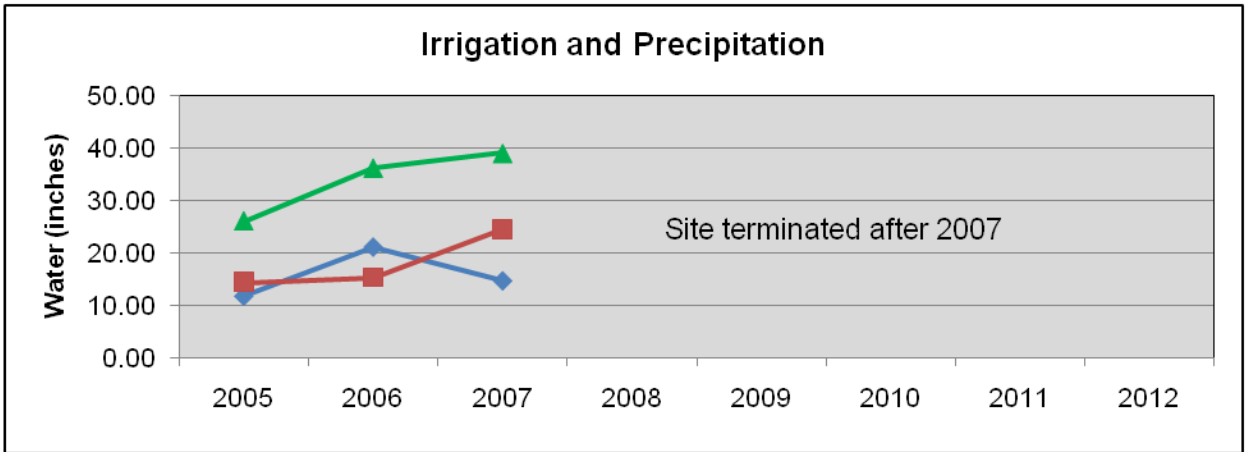
Comments: Drip irrigation cotton and corn system, conventional tillage with crops planted on forty-inch centers.

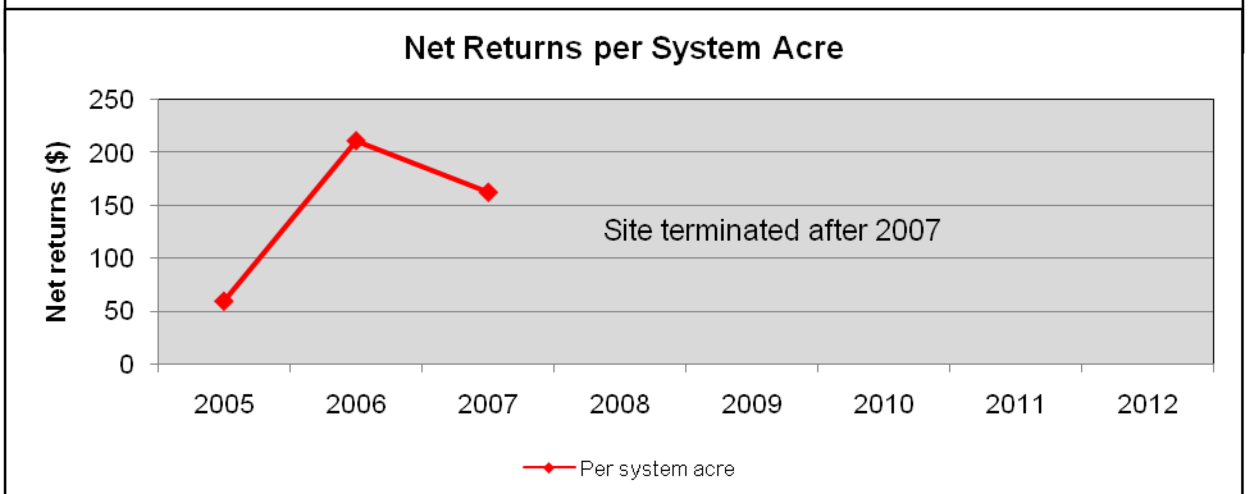
System 1

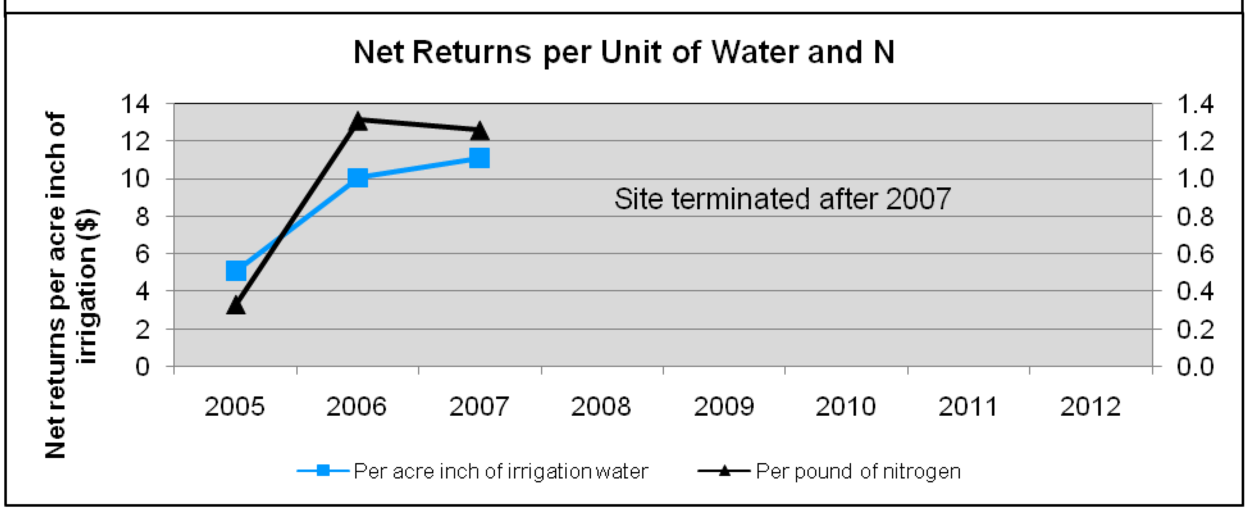
	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Cotton	Cotton		
2006	None	Cotton	Cotton	Cotton	Cotton
2007	None	Cotton	Cotton	Cotton	Cotton
2008	Site terminated in 2008				
2009					

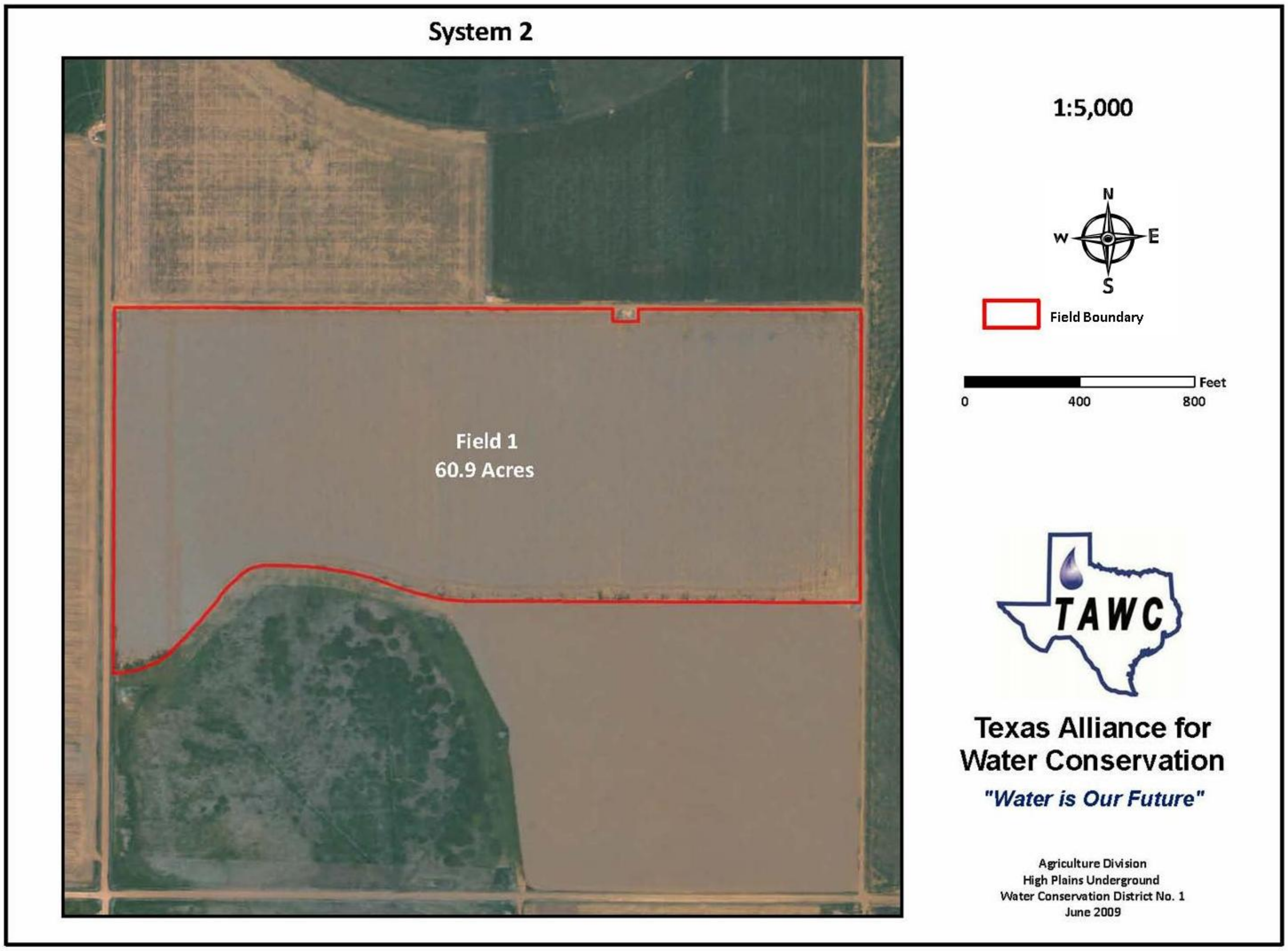


System 1


Irrigation and Precipitation
Water (inches)
50.00
40.00
30.00
20.00
10.00
0.00
Site terminated after 2007
2005
2006
2007
2008
2009
2010
2011
2012


Net Returns per System Acre
Net returns ($)
250
200
150
100
50
0
Site terminated after 2007
2005
2006
2007
2008
2009
2010
2011
2012
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
14
12
10
8
6
4
2
0
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Site terminated after 2007
2005
2006
2007
2008
2009
2010
2011
2012
Per acre inch of irrigation water
Per pound of nitrogen



System 2 Description

Total system acres: 60.9

Field No. 1 Acres: 60.9
Major soil type: Pullman clay loam, 0 to 1% slope
Olton clay loam, 1 to 3% slope

Irrigation

Type: Sub-surface Drip
(SDI, installed prior to 2004 crop year)

Pumping capacity, gal/min: 360

Number of wells: 2

Fuel source: Electric

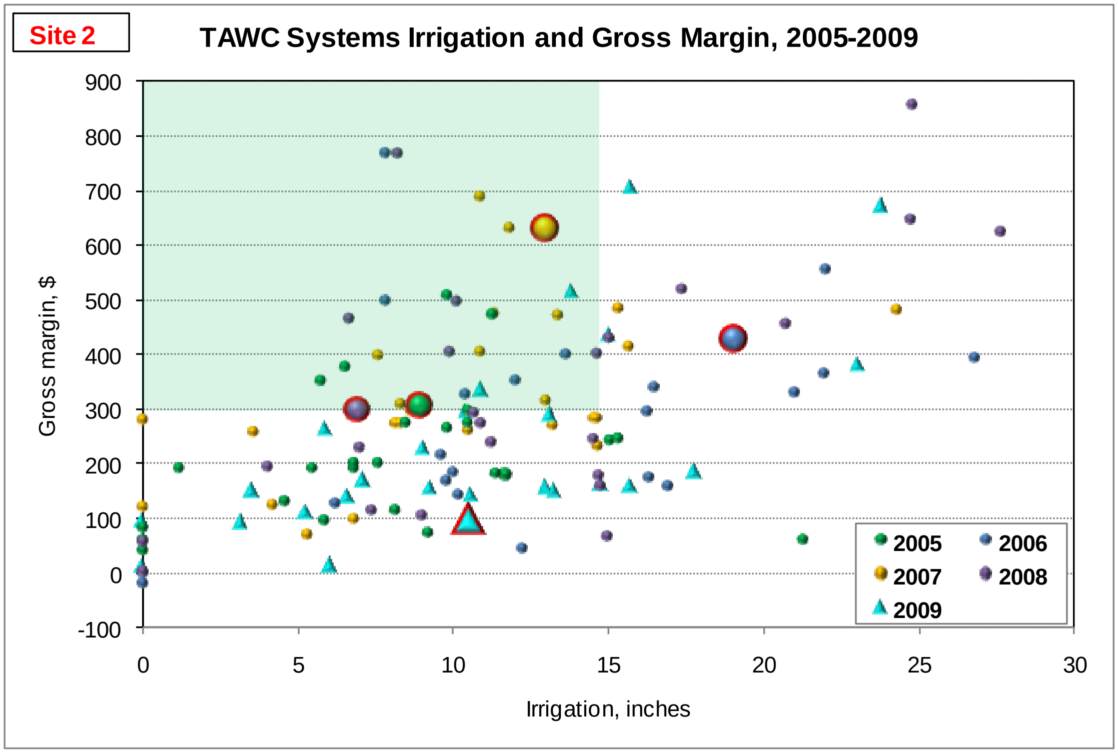
Comments: This drip site is planted on thirty-inch centers and has been planted to cotton or sunflowers.

System 2

	Livestock	Field 1
2005	None	Cotton
2006	None	Cotton
2007	None	Cotton
2008	None	Sunflowers
2009	None	Cotton

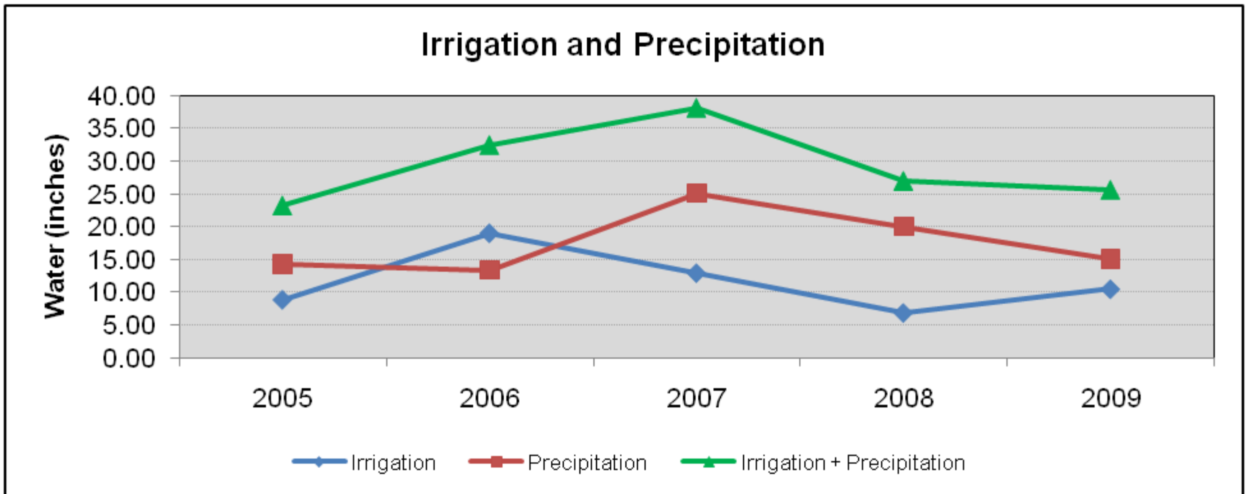
Site 2, Field 1 (July 2009)

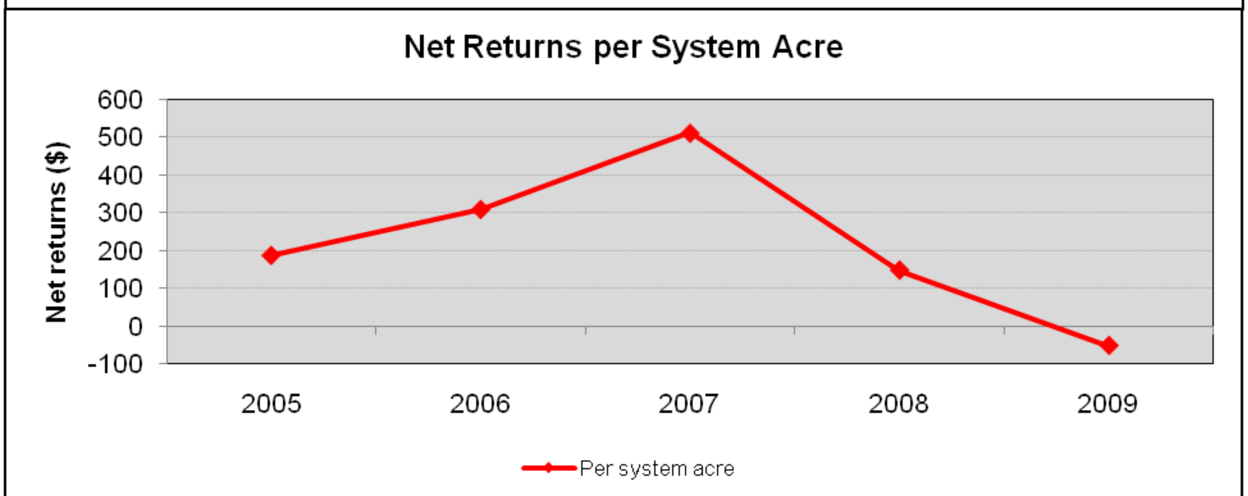
Site 2, Field 1 (November 2009)

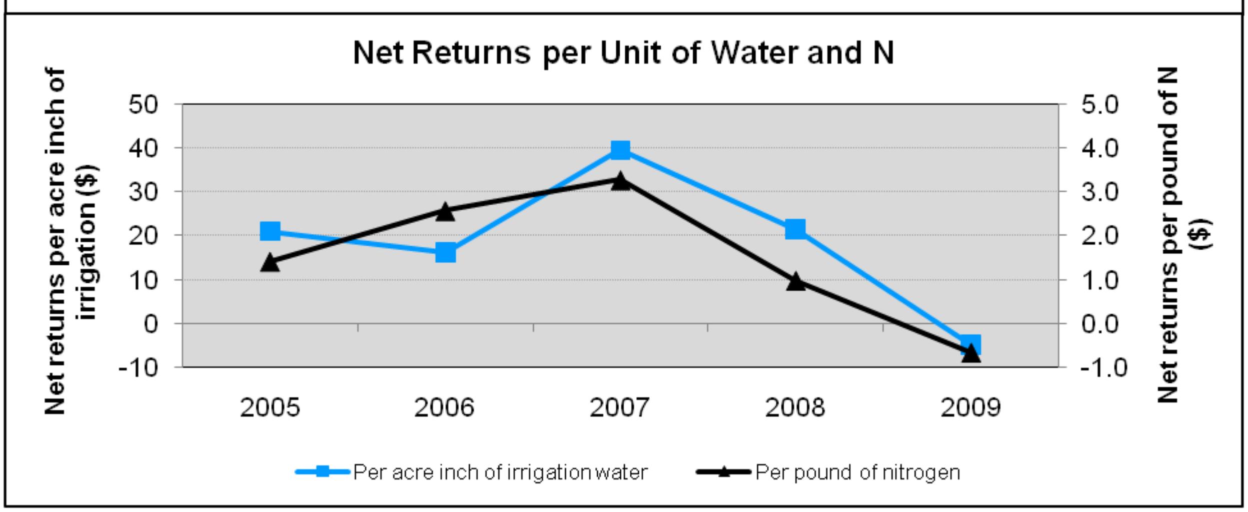


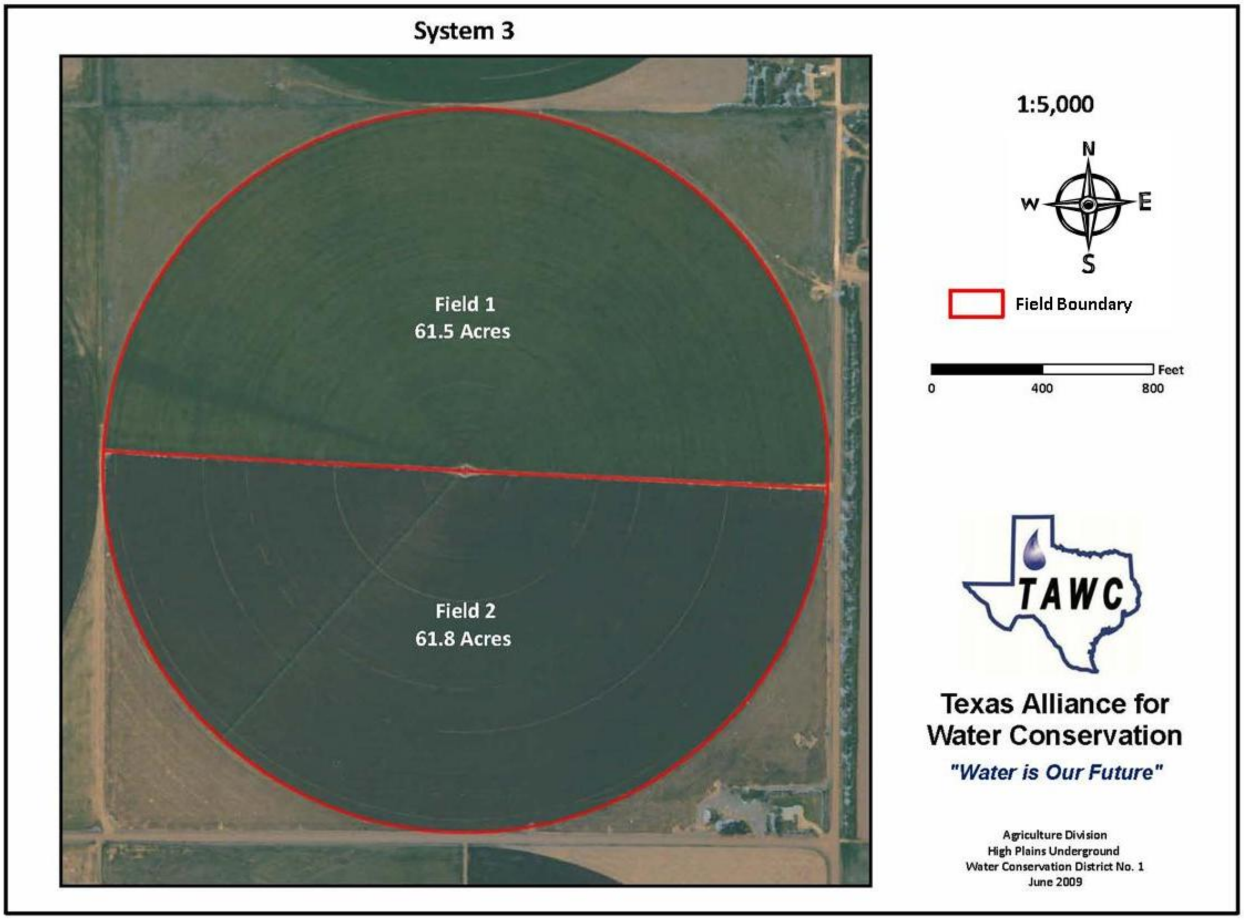
Site 2
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 2


Irrigation and Precipitation
Water (inches)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
600
500
400
300
200
100
0
-100
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
-10
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 3 Description

Total system acres: 123.3

Field No. 1 Acres: 61.5
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 61.8
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (MESA)

Pumping capacity, gal/min: 450

Number of wells: 2

Fuel source: 1 Natural gas
1 Electric

Comments: This is a pivot irrigated system, conventional tillage, and is planted on forty-inch centers. Crops have included cotton, wheat and grain sorghum.

System 3

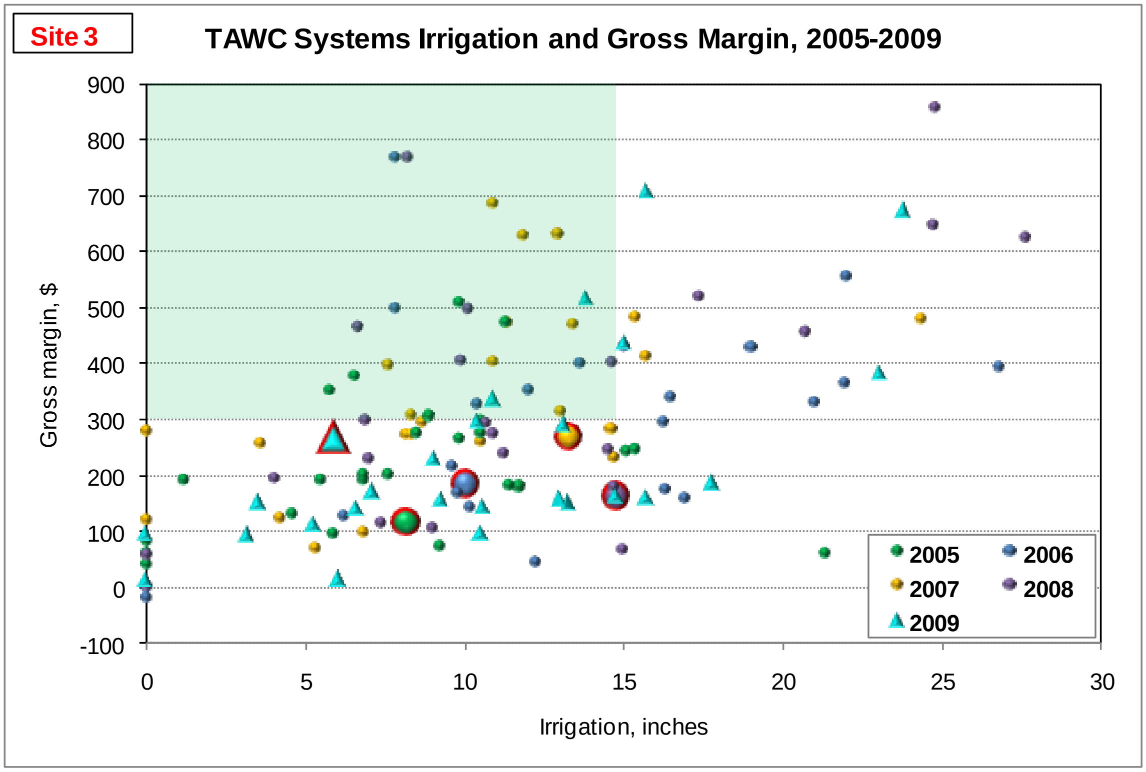
	Livestock	Field 1	Field 2
2005	None	Grain Sorghum	Cotton
2006	None	Cotton	Cotton
2007	None	Cotton following Wheat cover crop	Wheat for grain followed by Grain Sorghum
2008	None	Wheat for grain followed by Grain Sorghum	Cotton
2009	None	Wheat/Grain Sorghum	Cotton

Site 3, Field 1 (May 2009)

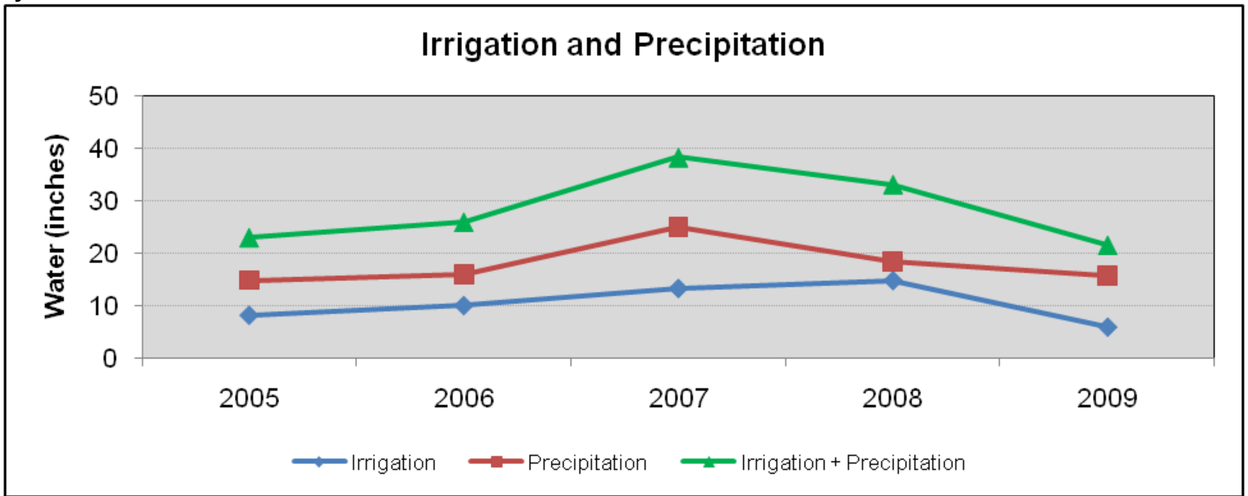
Site 3, Field 1 (July 2009)

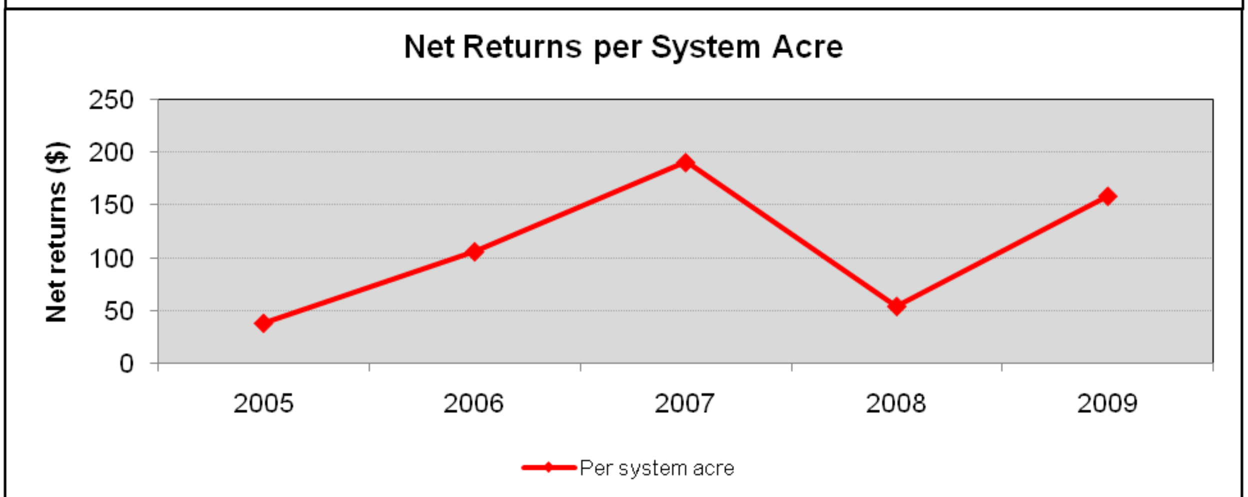
Site 3, Field 2 (July 2009)

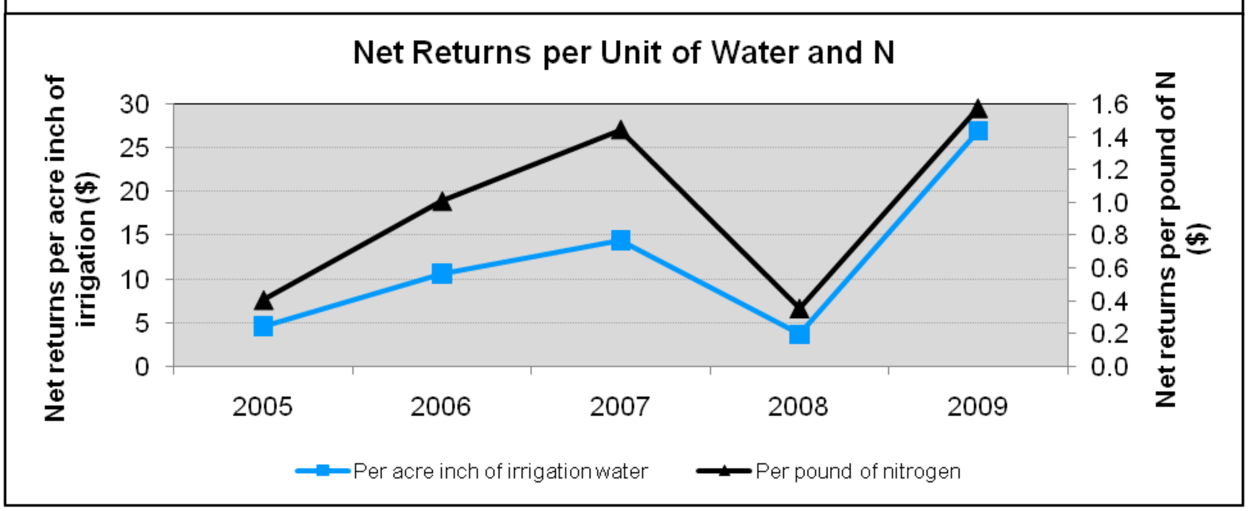
Site 3, Field 2 (September 2009)

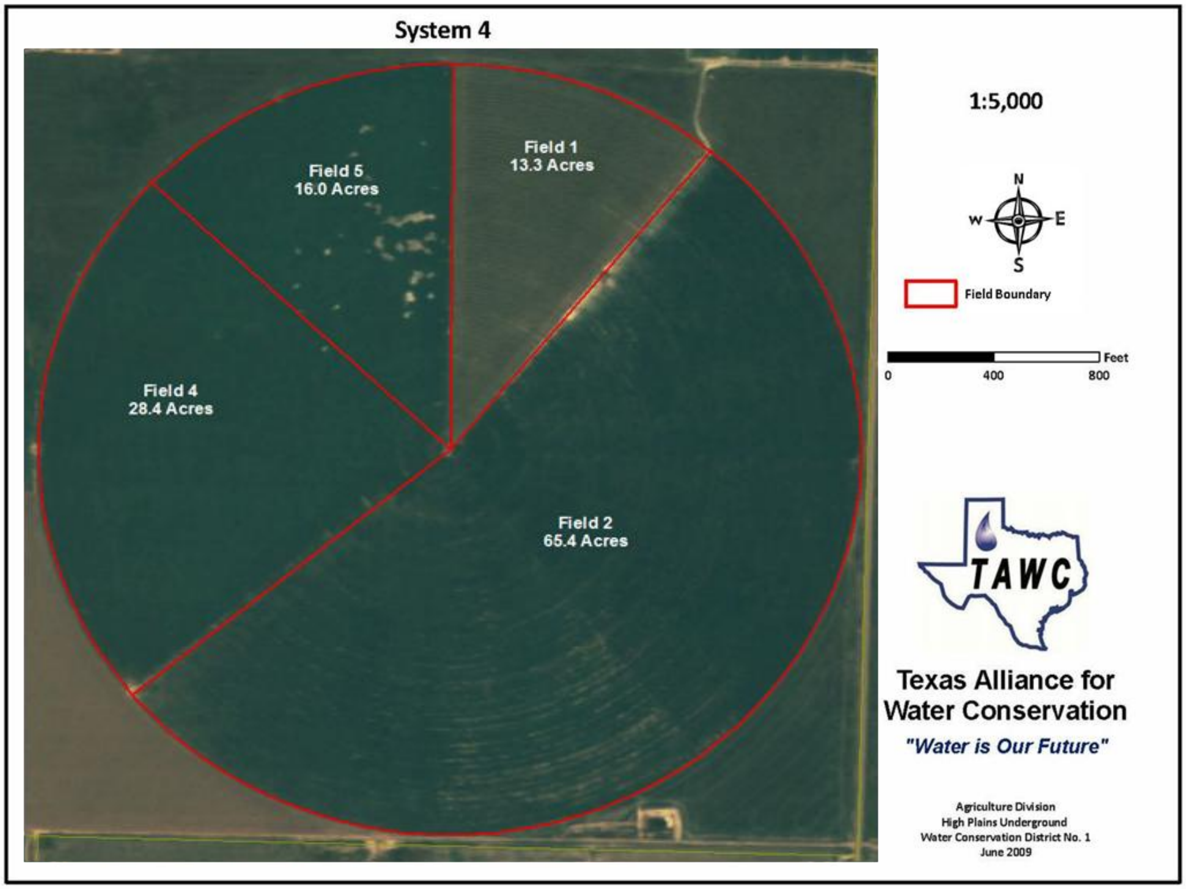

Site 3
TAWC Systems Irrigation and Gross Margin, 2005-2009
900
800
700
600
500
400
300
200
100
0
-100
Gross margin, $
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 3


Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
0
50
100
150
200
250
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
0
5
10
15
20
25
30
Net returns per pound of N ($)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 4 Description

Total system acres: 123.1

Field No. 1 Acres: 13.3
Major soil type: Estacado clay loam, 1 to 3% slope

Field No. 2 Acres: 65.4
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 4 Acres: 28.4
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 5 Acres: 16.0
Major soil type: Pullman clay loam, 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 500

Number of wells: 3

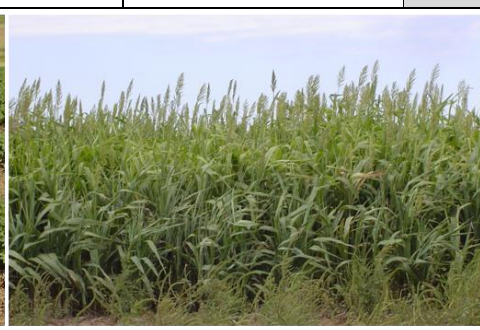
Fuel source: 1 Natural gas
2 Electric

Comments: Pivot irrigated system using conventional tillage. A new field of alfalfa was established this year. Cotton and grain sorghum comprised the balance of this system.

System 4

	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5
2005	None	Alfalfa for hay	Cotton following Wheat cover crop	Cotton following Wheat cover crop		
2006	None	Alfalfa for hay	Wheat for silage, followed by Forage Sorghum for silage and hay	Cotton		
2007	Cow-calf	Alfalfa for hay	Wheat for grazing (winter-spring) and cover crop, followed by Cotton	Wheat for grain, followed by Wheat for grazing (fall-winter)		
2008	Cow-calf	Alfalfa for hay	Grain Sorghum	Wheat for grain, followed by Wheat for grazing (fall-winter) and partly planted to Alfalfa		
2009	None	Cotton	Wheat/hay	Split into Fields 4 and 5	Grain Sorghum	Alfalfa

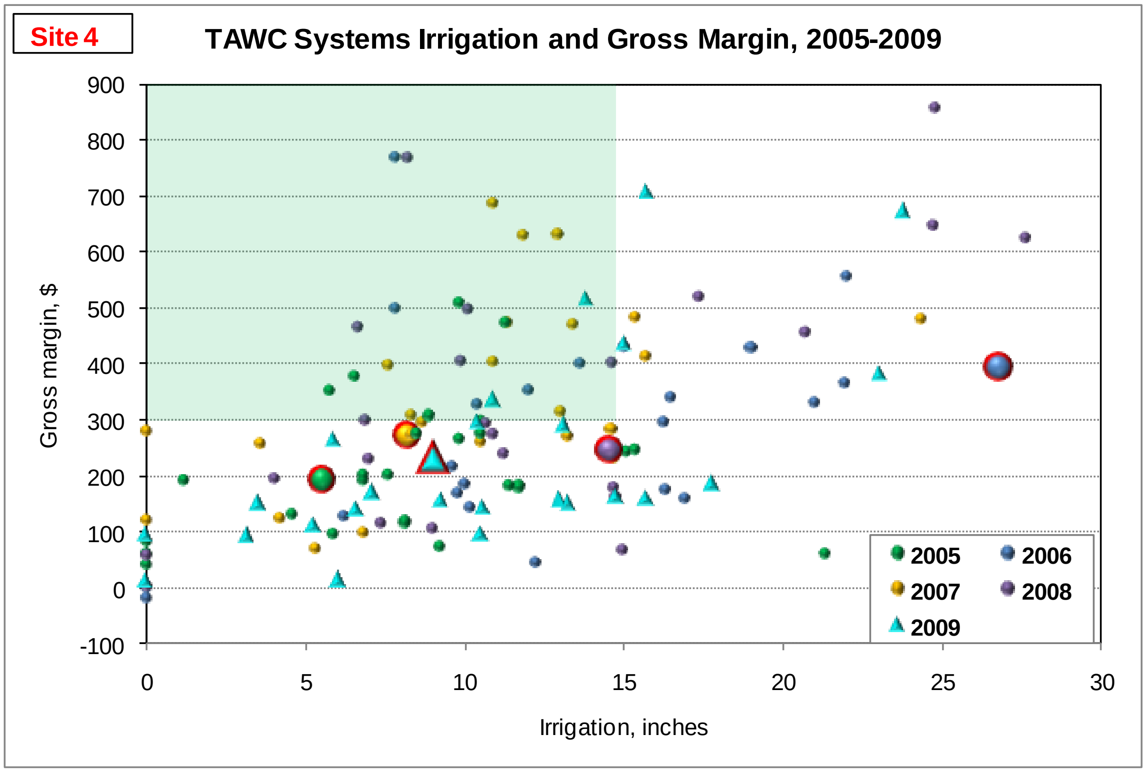
Site 4, Field 1 (July 2009)



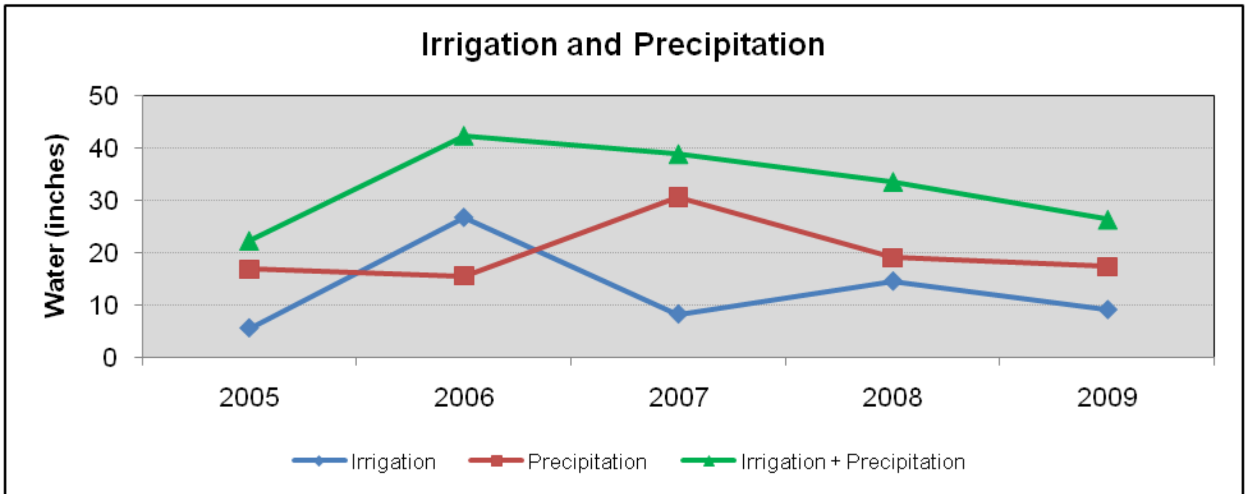
Site 4, Field 2 (September 2009)

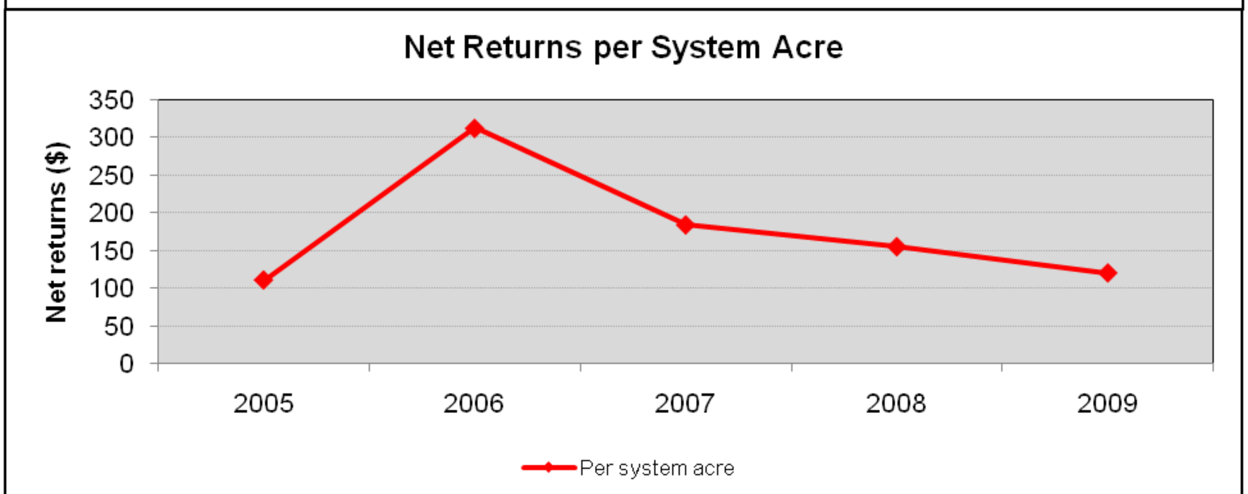
Site 4, Field 4 (July 2009)

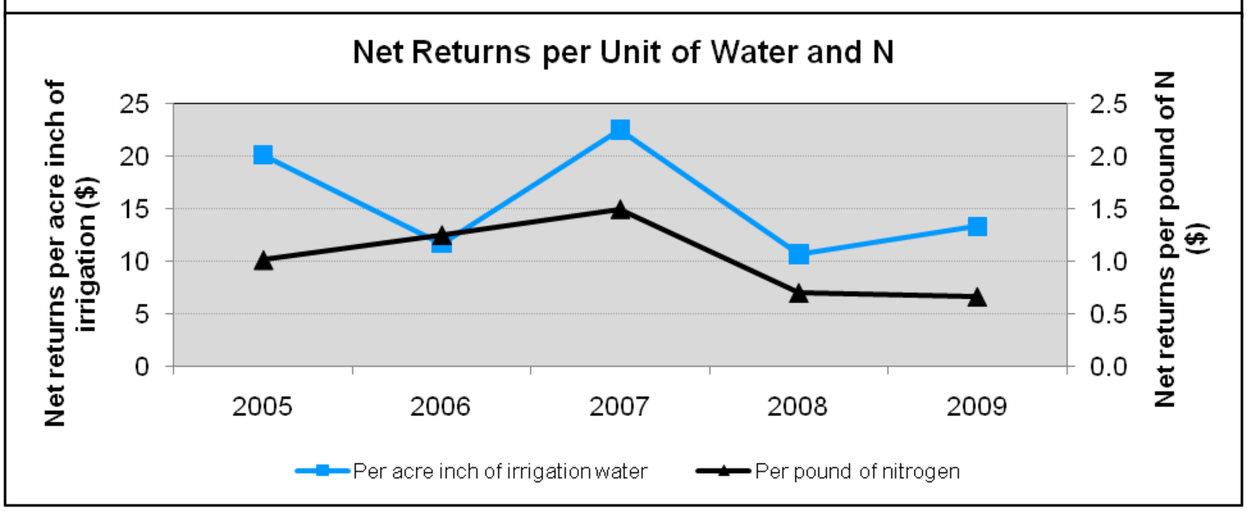
Site 4, Field 5 (September 2009)

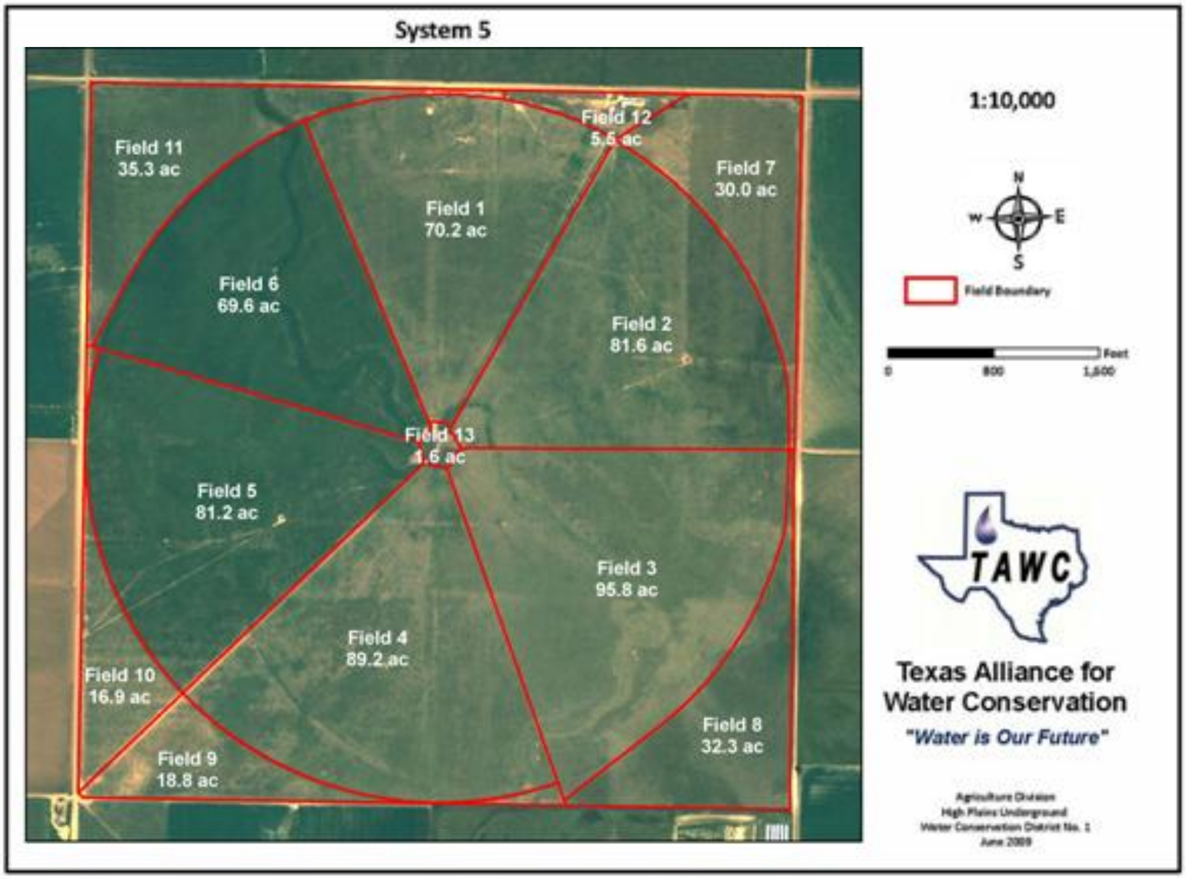

Site 4
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 4


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
25
20
15
10
5
0
2.5
2.0
1.5
1.0
0.5
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 5 Description

Total system acres: 628.0
(487.6 irrigated; 133.3 dryland, 7.1 facilities)

IRRIGATED

Field No. 1 Acres: 70.2
Major soil type: Bippus loam, 0 to 1% slope
Mansker loam, 0 to 3% slope

Field No. 2 Acres: 81.6
Major soil type: Bippus loam, 0 to 1% slope
Mansker loam, 0 to 3 and 3 to 5% slope
Olton loam, 0 to 1% slope

Field No. 3 Acres: 95.8
Major soil type: Bippus loam, 0 to 1% slope

Field No. 4 Acres: 89.2
Major soil type: Bippus loam, 0 to 1% slope
Olton loam, 0 to 1 and 1 to 3% slope

Irrigation

Type: Center Pivot (MESA)

Pumping capacity, gal/min: 1100

Number of wells: 4

Fuel source: Electric

Field No. 5 Acres: 81.2
Major soil type: Olton loam, 0 to 1% slope
Bippus loam, 0 to 1% slope
Mansker loam, 0 to 3% slope

Field No. 6 Acres: 69.6
Major soil type: Bippus loam, 0 to 1% slope

DRYLAND

Field No. 7 Acres: 30.0
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 8 Acres: 32.3
Major soil type: Bippus loam, 0 to 1% slope
Randall clay
Estacado loam, 1 to 3% slope

Field No. 9 Acres: 18.8
Major soil type: Olton loam, 1 to 3% slope
Mansker loam, 3 to 5% slope
Bippus fine sandy loam, overwash, 1 to 3% slope

Field No. 10 Acres: 16.9
Major soil type: Olton loam, 0 to 1% slope
Pullman clay loam, 0 to 1% slope

Field No. 11 Acres: 35.3
Major soil type: Bippus loam, 0 to 1% slope

Field No. 12 and 13 Acres: 7.1
Major soil type: Pens and barns

Comments: This is a commercial, spring calving cow/calf operation. The 487.6 acres of irrigated grass is divided into six cells. This producer usually moves all cattle off site in early winter after the calves are weaned. Cows will calve on wheat and are moved back on site.

System 5 *Crops - Irrigated*

	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
2005	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama mixture for grazing	Alfalfa/Plains/Blue grama/Klein mixture for grazing
2006	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Blue grama/Dahl mixture for grazing and hay	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama mixture for grazing	Alfalfa/Plains/blue grama/Klein mixture for grazing
2007	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama/Dahl mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Dahl mixture for grazing and hay	Dahl/Green sprangletop/Plains mixture for grazing and hay
2008	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama/Dahl mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Dahl mixture for grazing and hay	Dahl/Green sprangletop/Plains mixture for grazing and hay
2009	Cow-calf	Klein/Plains/Dahl/Blue grama/Buffalograss mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Plains/Klein/Blue grama/Dahl mixture for grazing	Plains/Blue grama/Klein mixture for grazing	Renovated, Plains/Klein/Dahl mixture for grazing and hay	Dahl/Green sprangletop/Plains mixture for grazing and hay

Site 5 (March, 2009)

Site 5 (April, 2009)

Site 5 (May, 2009)

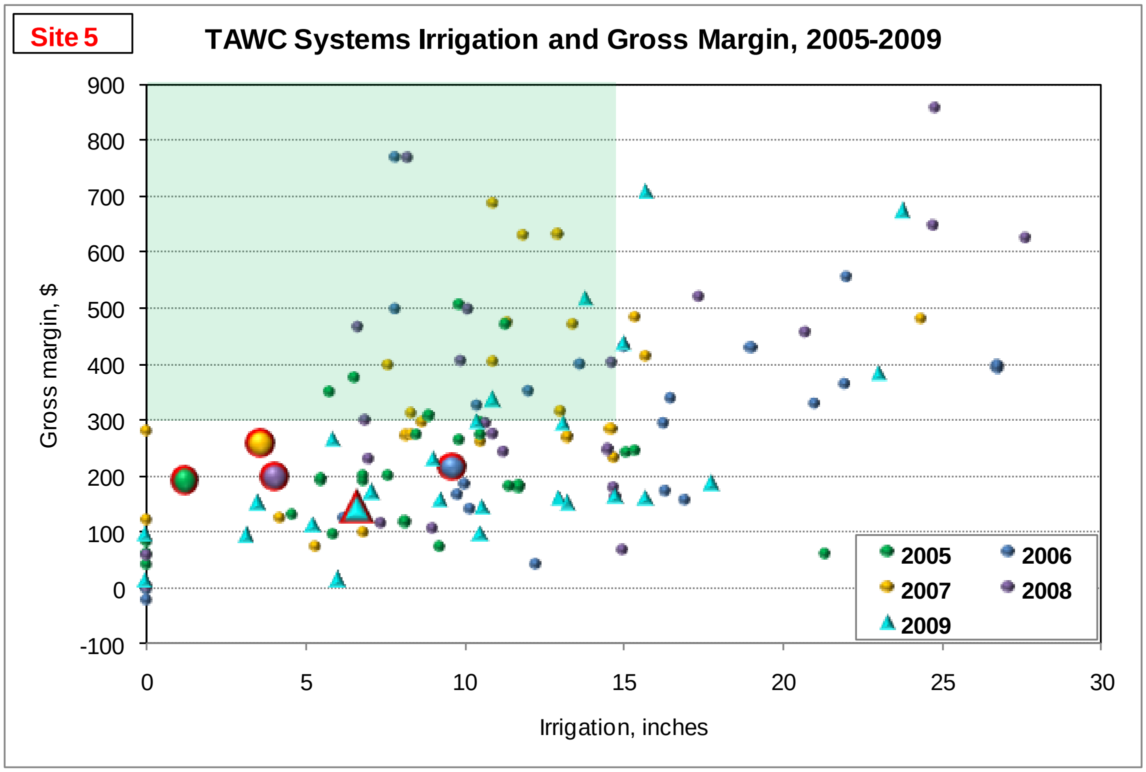
System 5 *Crops - Dryland*

	Field 7	Field 8	Field 9	Field 10	Field 11	Fields 12 and 13
2005	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2006	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2007	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2008	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns
2009	Plains/Blue grama mixture for grazing	Plains/Blue grama/Sand dropseed/Buffalograss mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Plains/Blue grama mixture for grazing	Pens and barns


Site 5 (July, 2009)

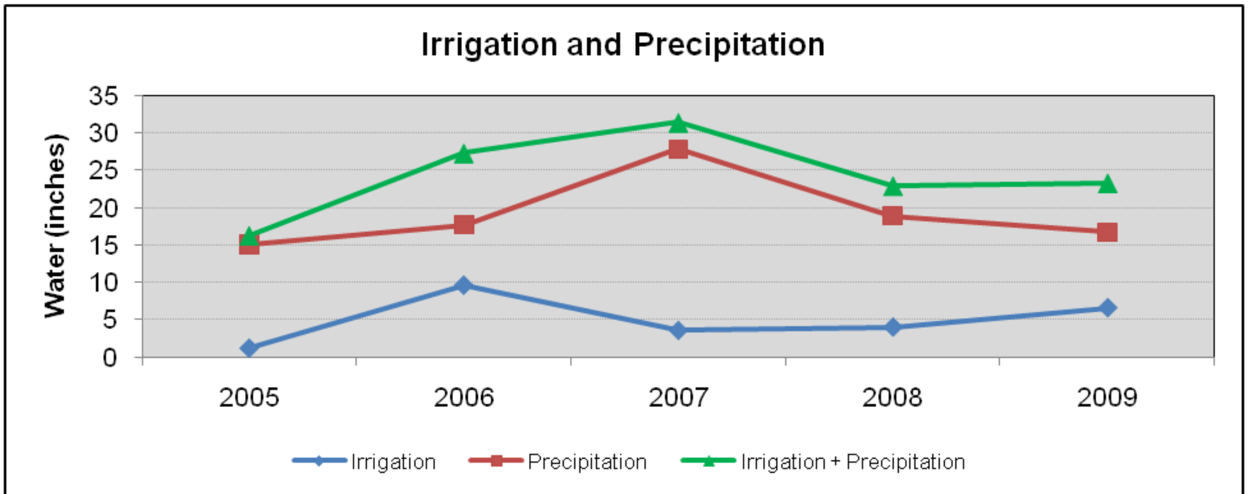

Site 5 (August, 2009)

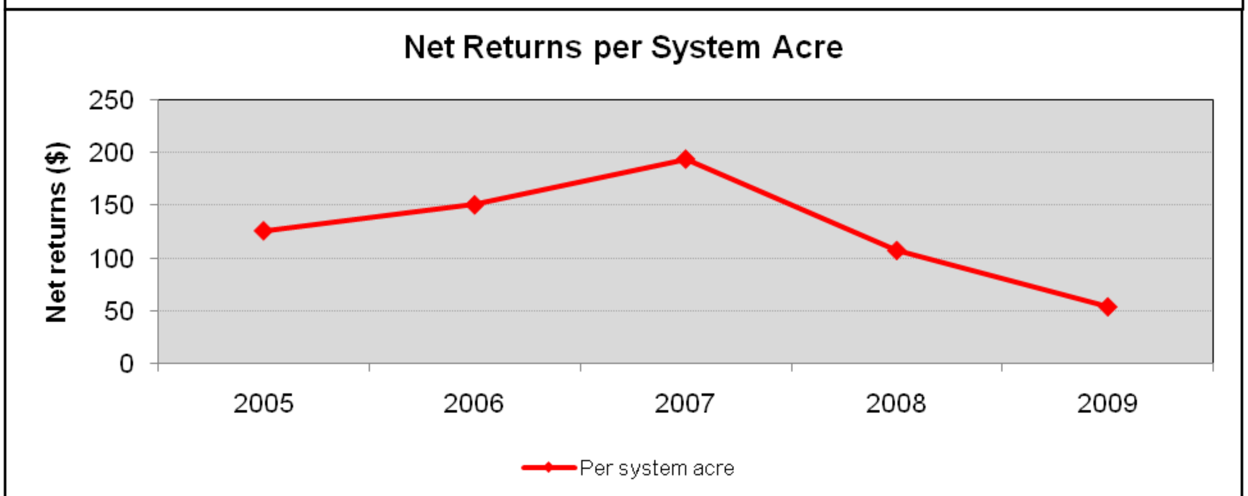

Site 5 (October, 2009)

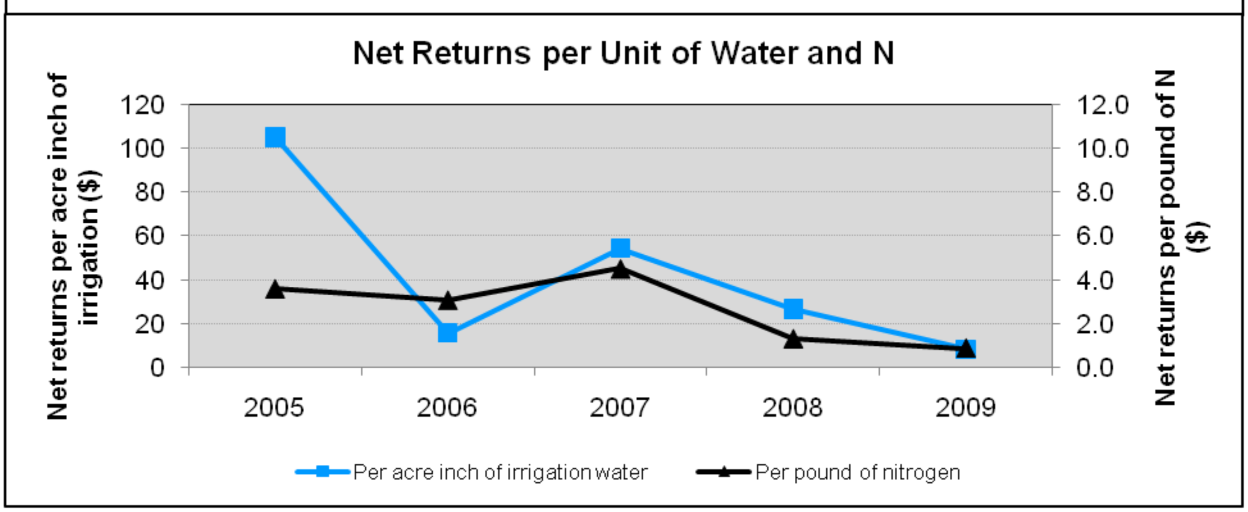


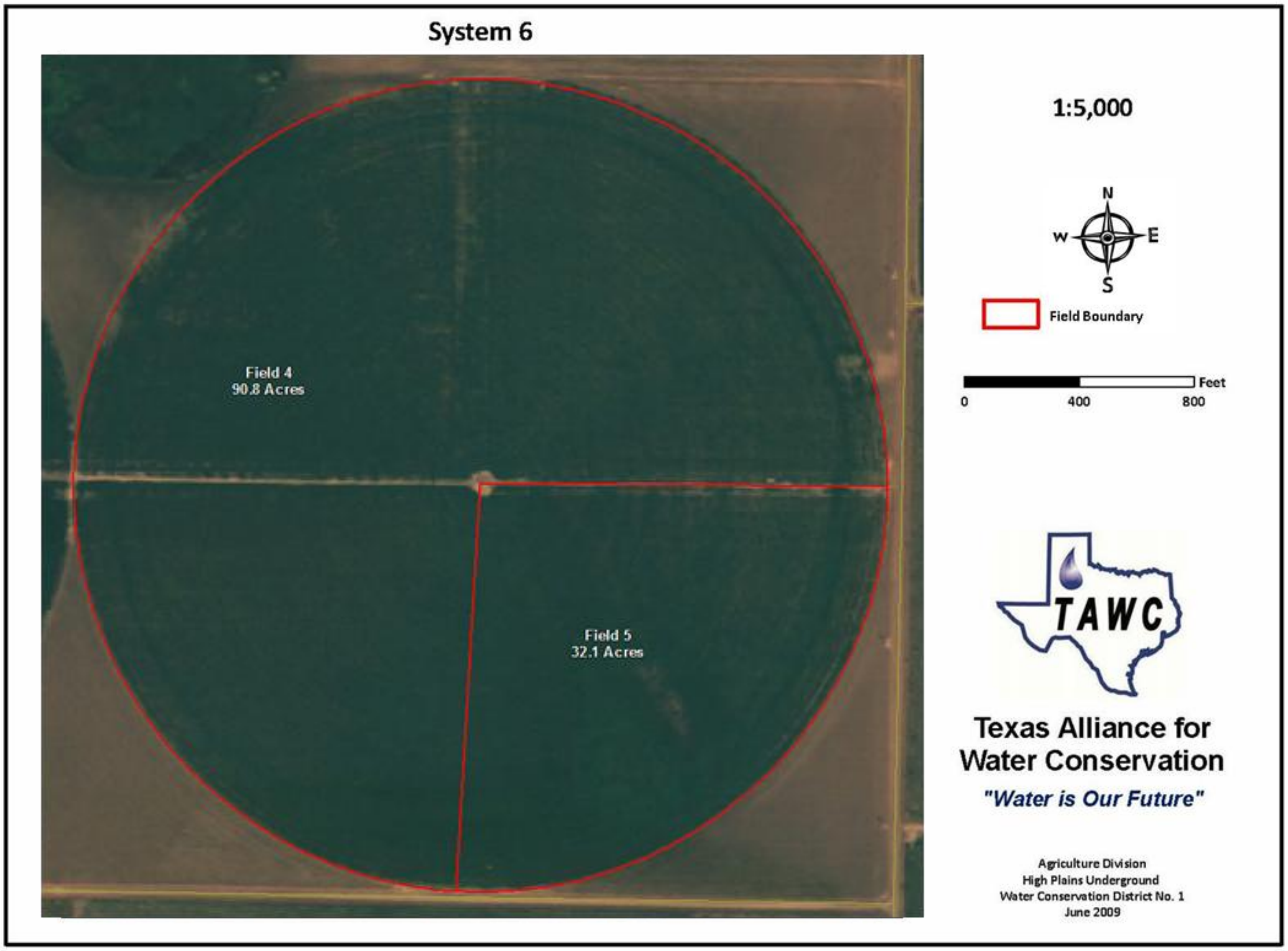
Site 5
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 5


Irrigation and Precipitation
Water (inches)
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
250
200
150
100
50
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
120
100
80
60
40
20
0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 6 Description

Total system acres: 122.9

Field No. 4 Acres: 90.8
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 5 Acres: 32.1
Major soil type: Pullman clay loam, 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 500

Number of wells: 4

Fuel source: Natural gas

Comments: One fourth of this site is planted to corn with the balance planted to cotton on forty-inch centers. This producer uses conventional tillage.

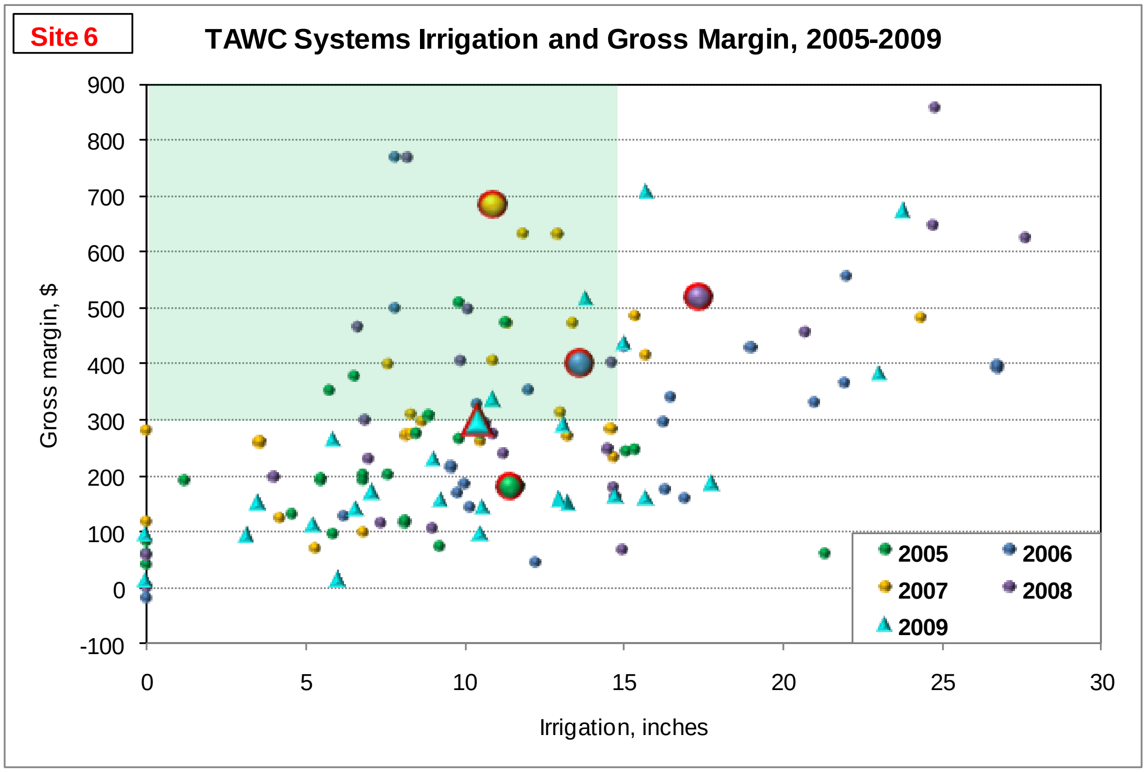
System 6

	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5
2005	Stocker steers	Wheat for grazing and cover followed by Cotton				
2006	None	Cotton				
2007	None	Cotton				
2008	None	Split into Fields 2 and 3	Cotton	Corn for grain		
2009	None		Split into Fields 4 and 5		Cotton	Corn

Site 6, Field 4 (September 2009)

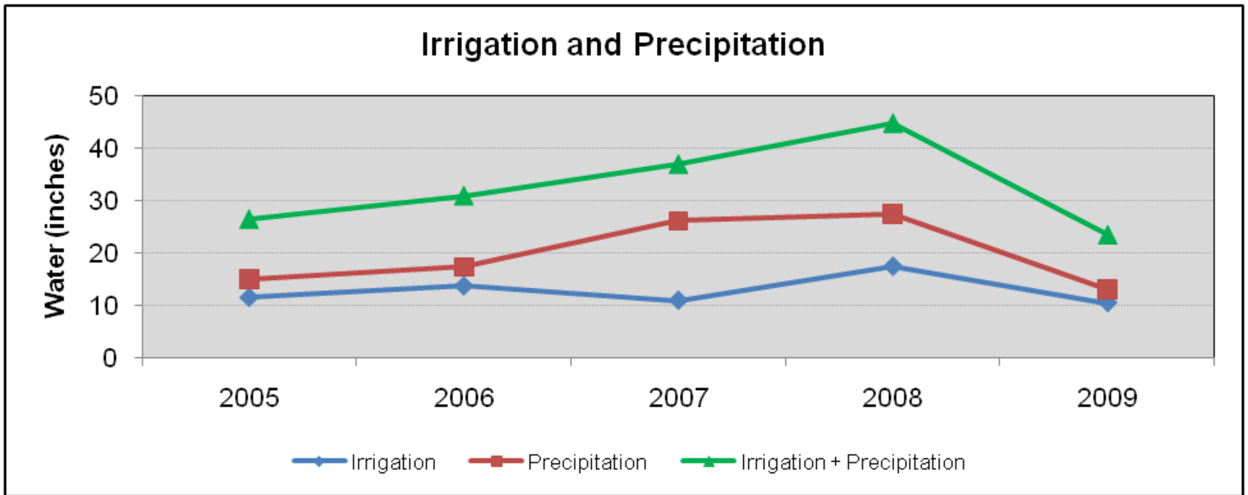
Site 6, Field 5 (May 2009)

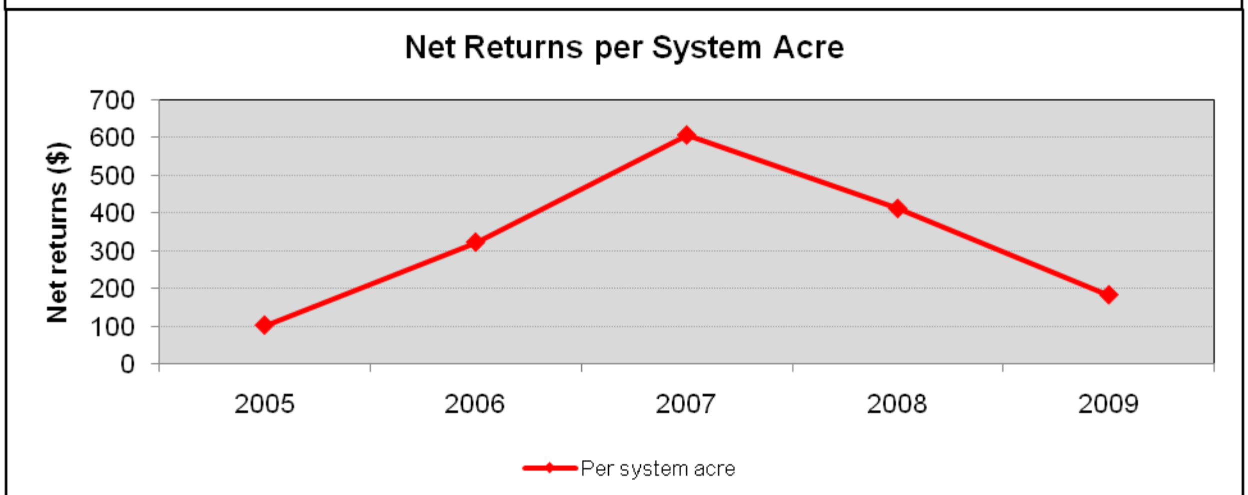
Site 6, Field 5 (July 2009)

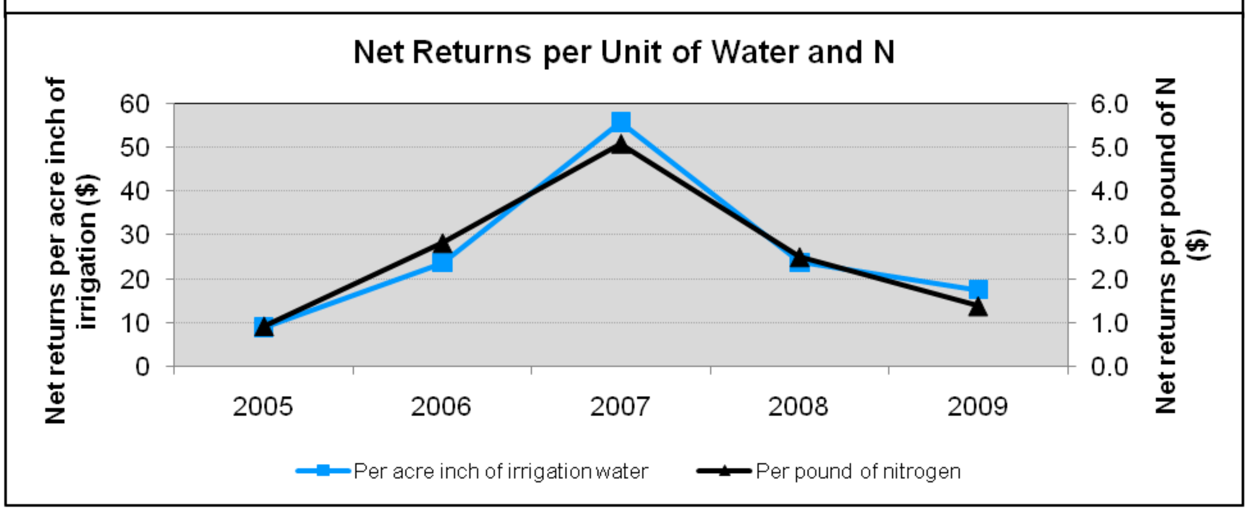


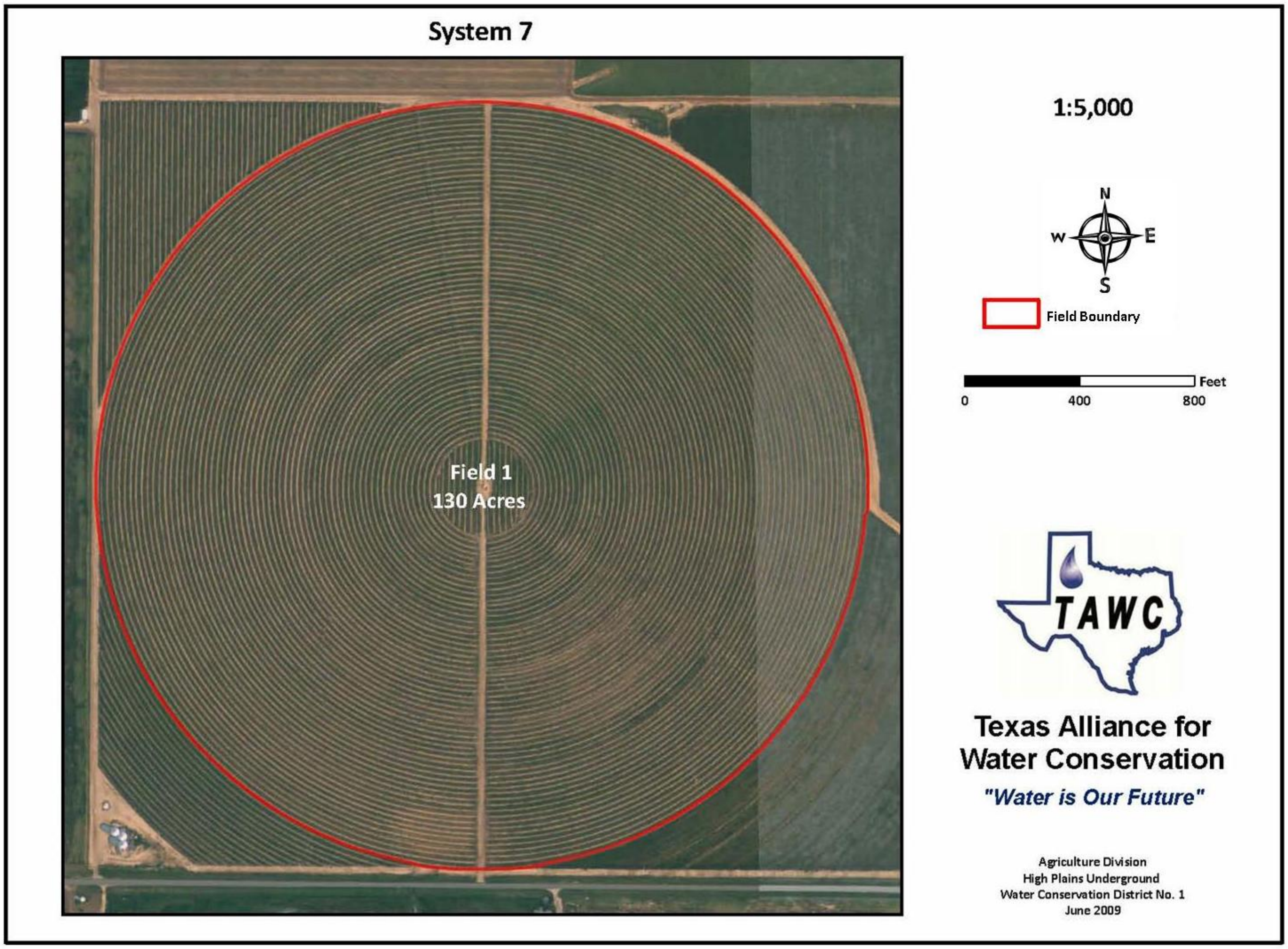
Site 6
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 6


Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
0
100
200
300
400
500
600
700
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
Net returns per pound of N ($)
0
10
20
30
40
50
60
0.0
1.0
2.0
3.0
4.0
5.0
6.0
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 7 Description

Total system acres: 130.0

Field No. 1 Acres: 130.0
Major soil type: Pullman clay loam, 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 500

Number of wells: 4

Fuel source: Electric

Comments: This is a pivot irrigated field of side-oats grama grown for seed production and the grass residue is baled for hay and sold. This field was established fifteen years ago.

System 7

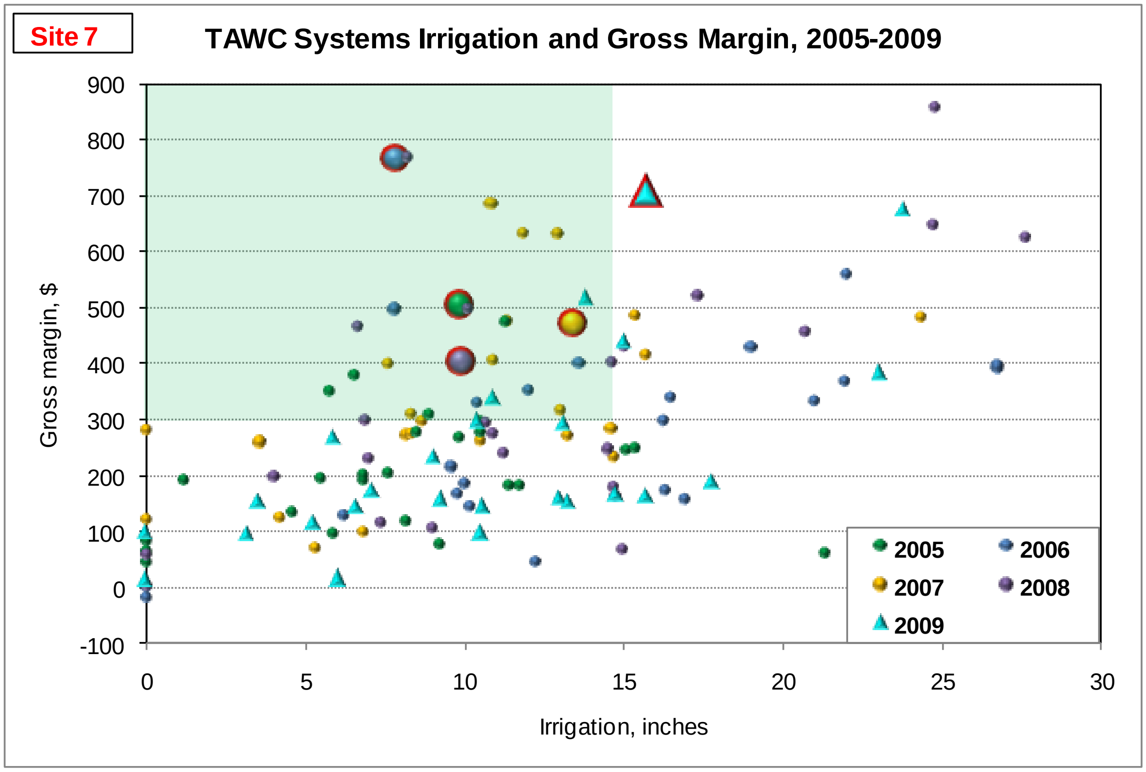
	Livestock	Field 1
2005	None	Sideoats grama for seed and hay
2006	None	Sideoats grama for seed and hay
2007	None	Sideoats grama for seed and hay
2008	None	Sideoats grama for seed and hay
2009	None	Sideoats grama for seed and hay

Site 7, Field 1 (April 2009)

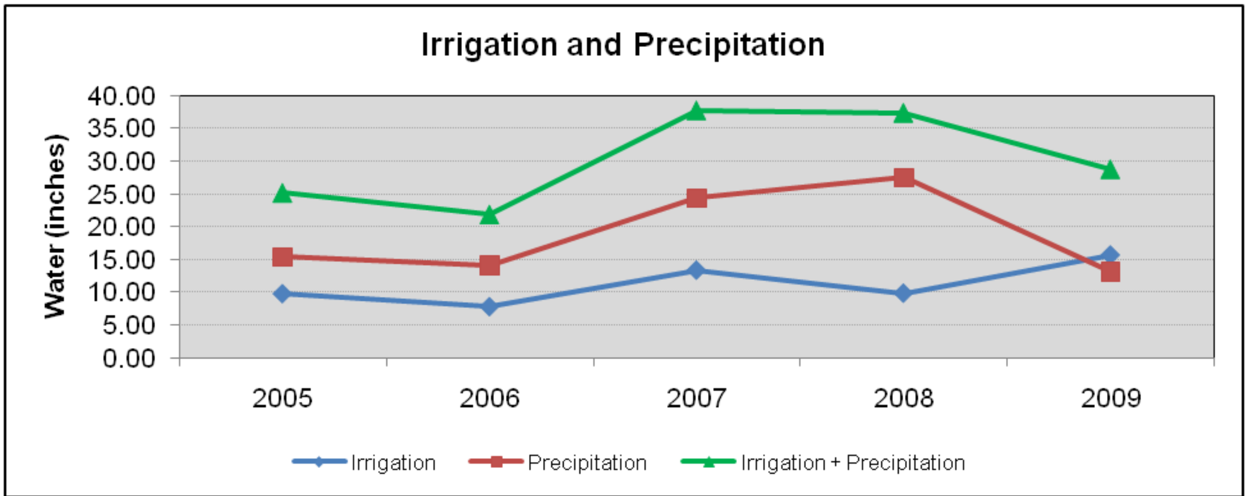
Site 7, Field 1 (June 2009)

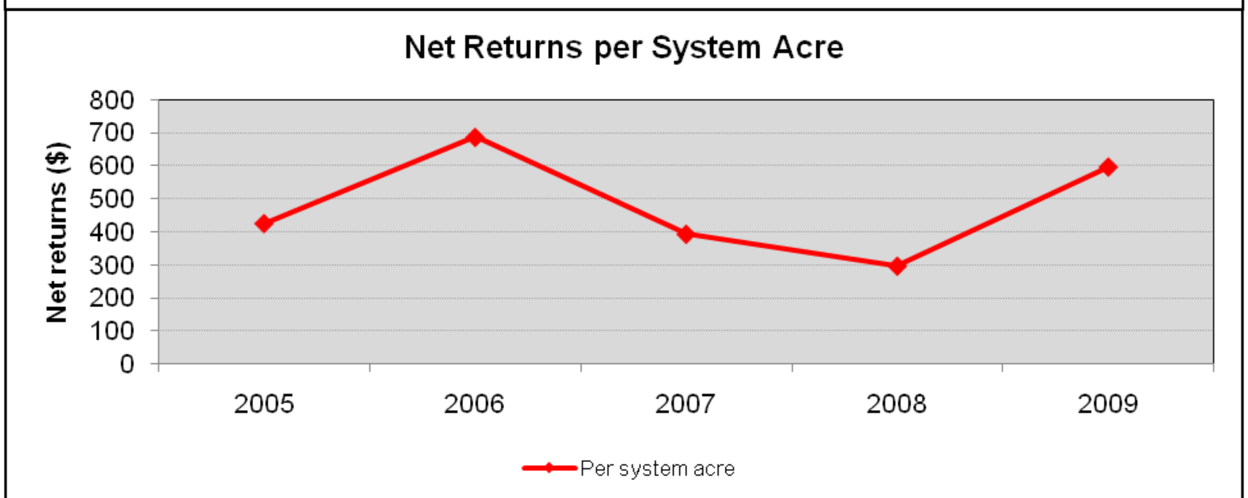
Site 7, Field 1 (August 2009)

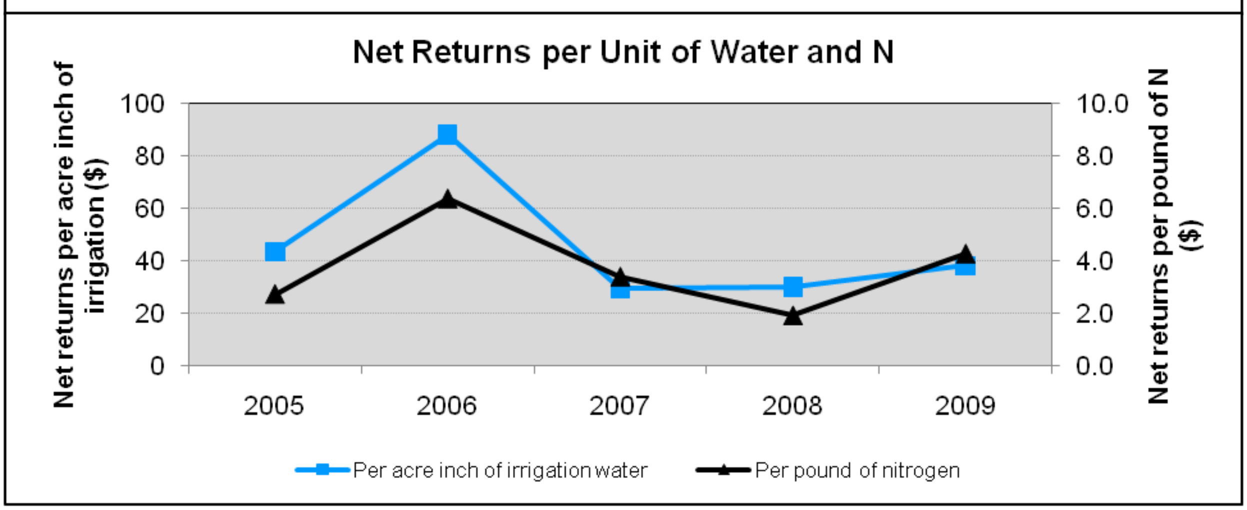
Site 7, Field 1 (September 2009)

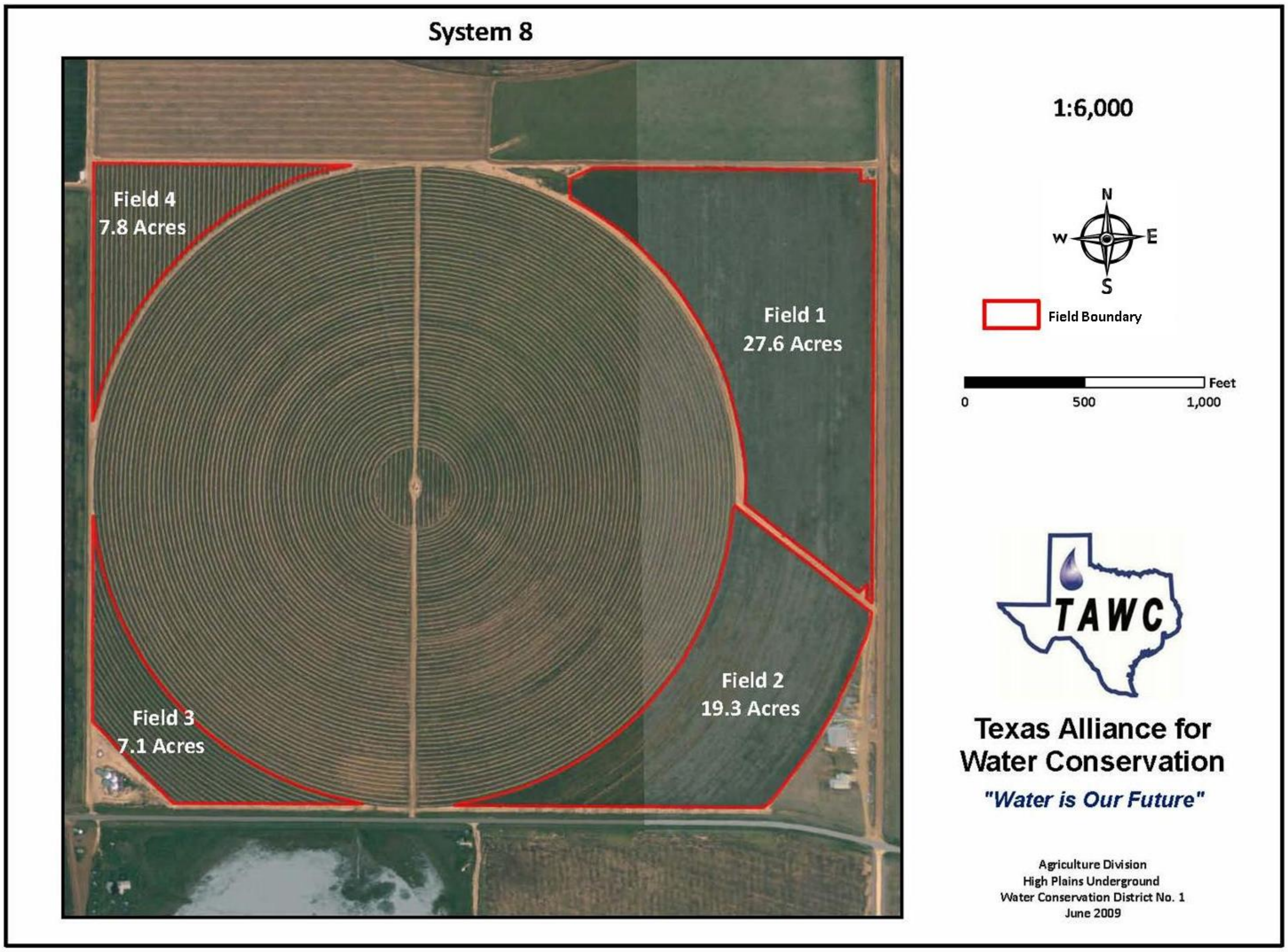

Site 7
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 7


Irrigation and Precipitation
Water (inches)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
800
700
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
100
80
60
40
20
0
Net returns per pound of N ($)
10.0
8.0
6.0
4.0
2.0
0.0
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 8 Description

Total system acres: 61.8

Field No. 1 Acres: 27.6
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 2 Acres: 19.3
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 3 Acres: 7.1
Major soil type: Pullman clay loam, 0 to 1% slope

Field No. 4 Acres: 7.8
Major soil type: Pullman clay loam, 0 to 1% slope

Irrigation

Type: Sub-surface Drip (SDI)

Pumping capacity, gal/min: 360

Number of wells: 4

Fuel source: Electric

Comments: This is a drip irrigated field of side-oats grama grown for seed production and the grass residue is baled for hay and sold. These four fields were put into drip six years ago. Prior to the installation of drip these fields were furrow irrigated.

System 8

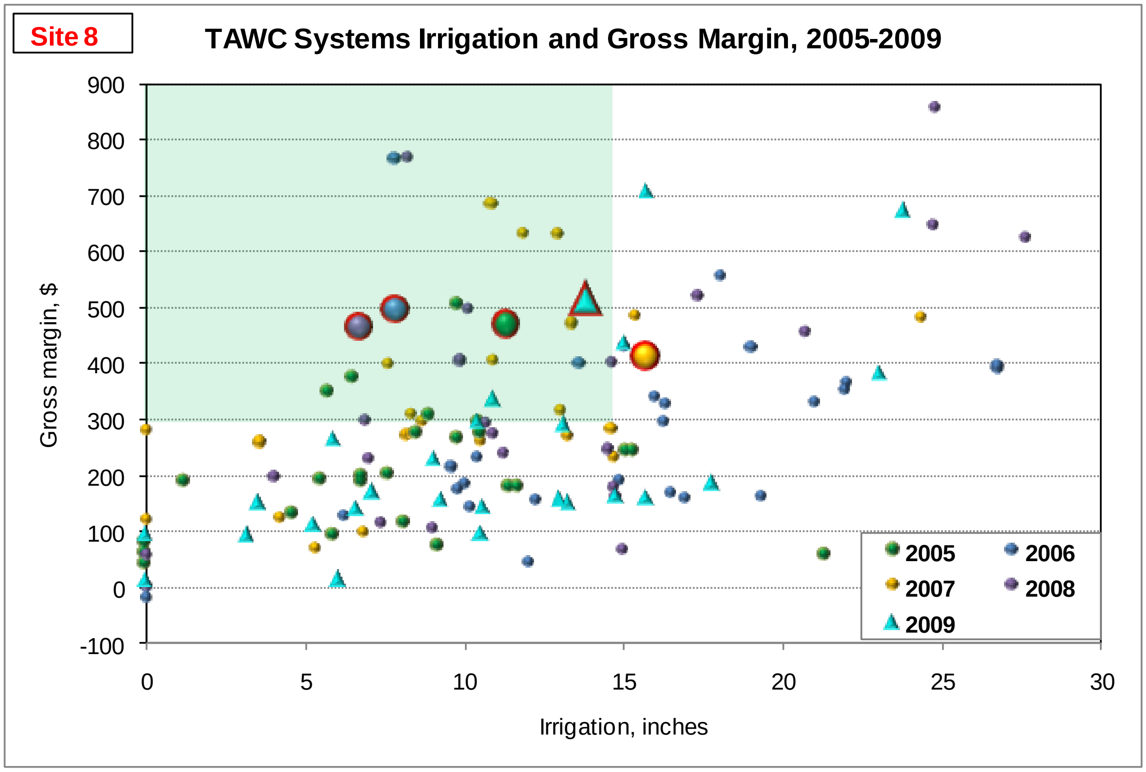
	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2006	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2007	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2008	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay
2009	None	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay	Sideoats grama for seed and hay

Site 8 (April 2009)

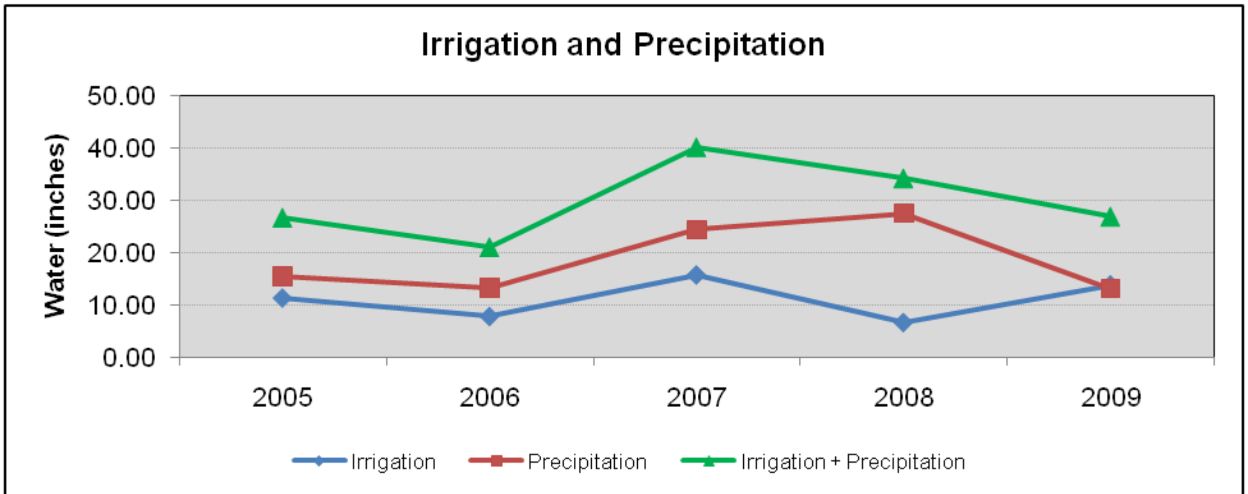
Site 8 (June 2009)

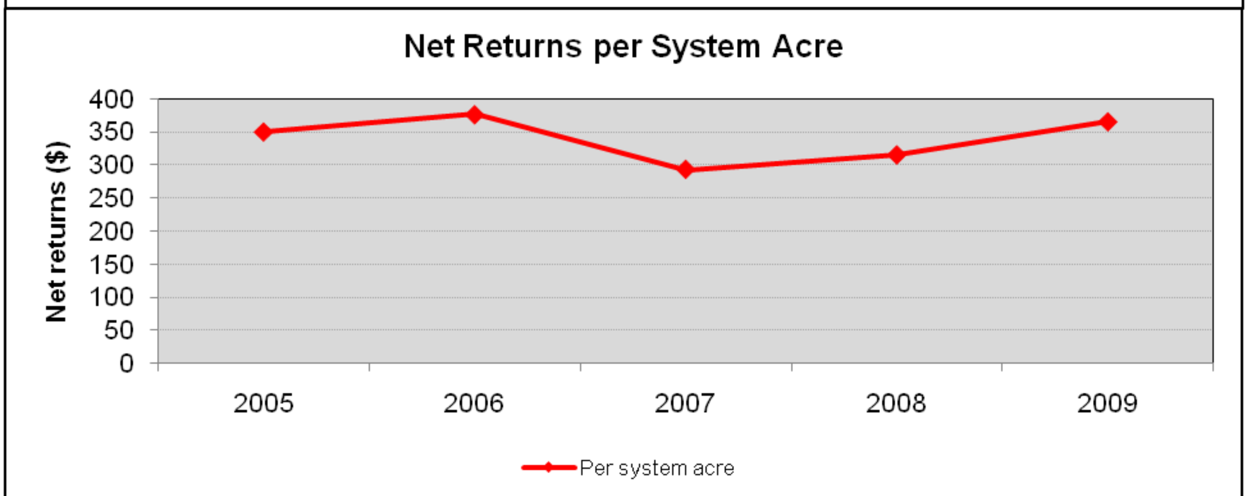
Site 8 (September 2009)

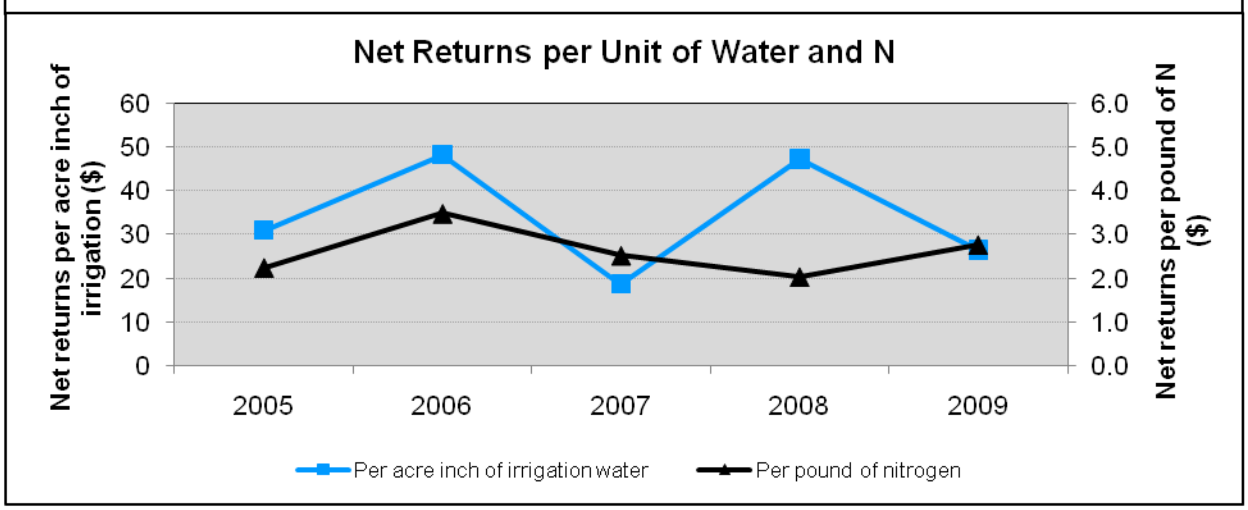
Site 8 (September 2009)

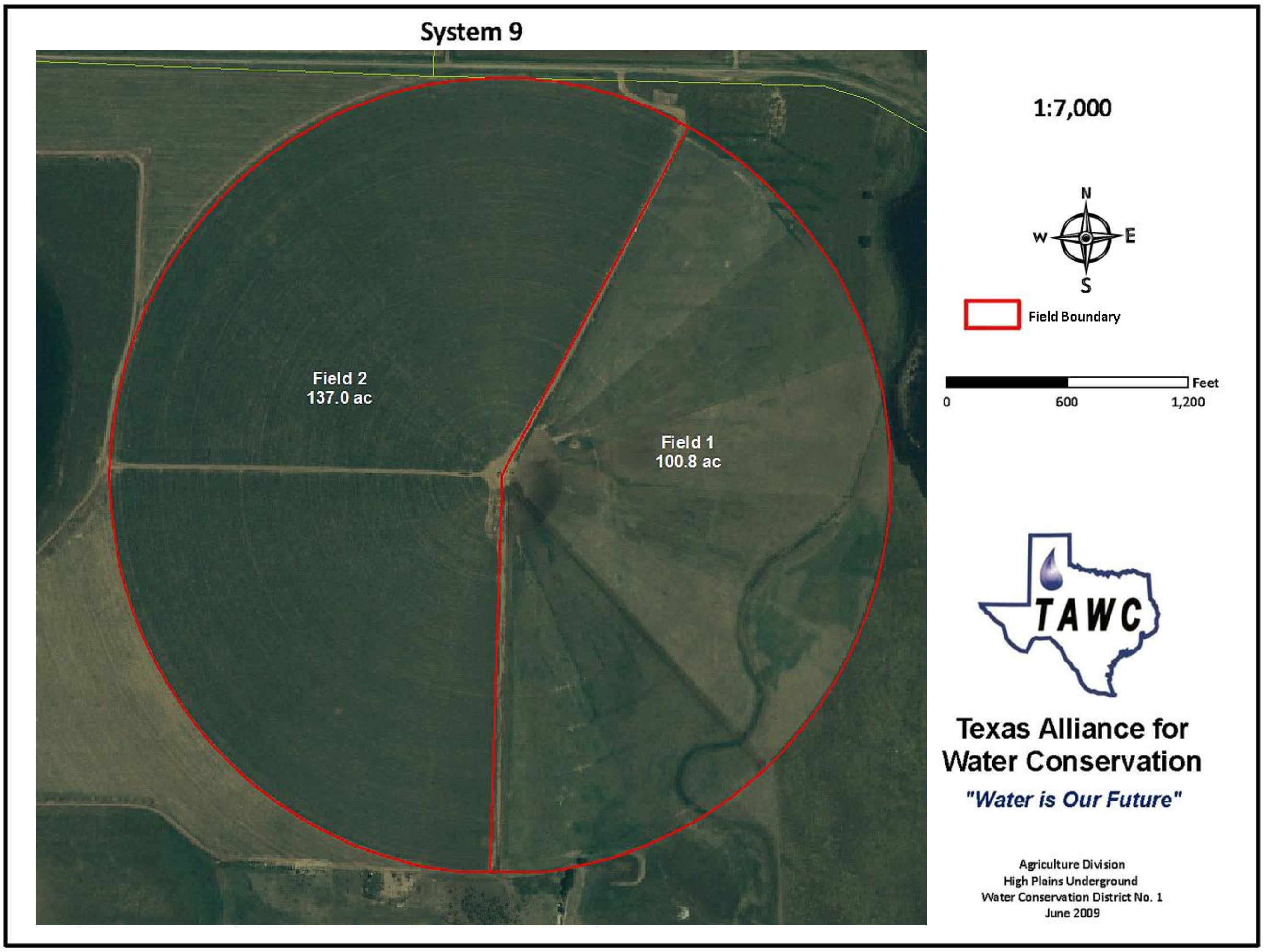

Site 8
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 8


Irrigation and Precipitation
Water (inches)
50.00
40.00
30.00
20.00
10.00
0.00
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
400
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
60
50
40
30
20
10
0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 9 Description

Total system acres: 237.8

Field No. 1 Acres: 100.8
Major soil type: Mixed shallow soils

Field No. 2 Acres: 137.0
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (MESA)
Pumping capacity, gal/min: 900

Number of wells: 4

Fuel source: 2 Natural gas
2 Diesel

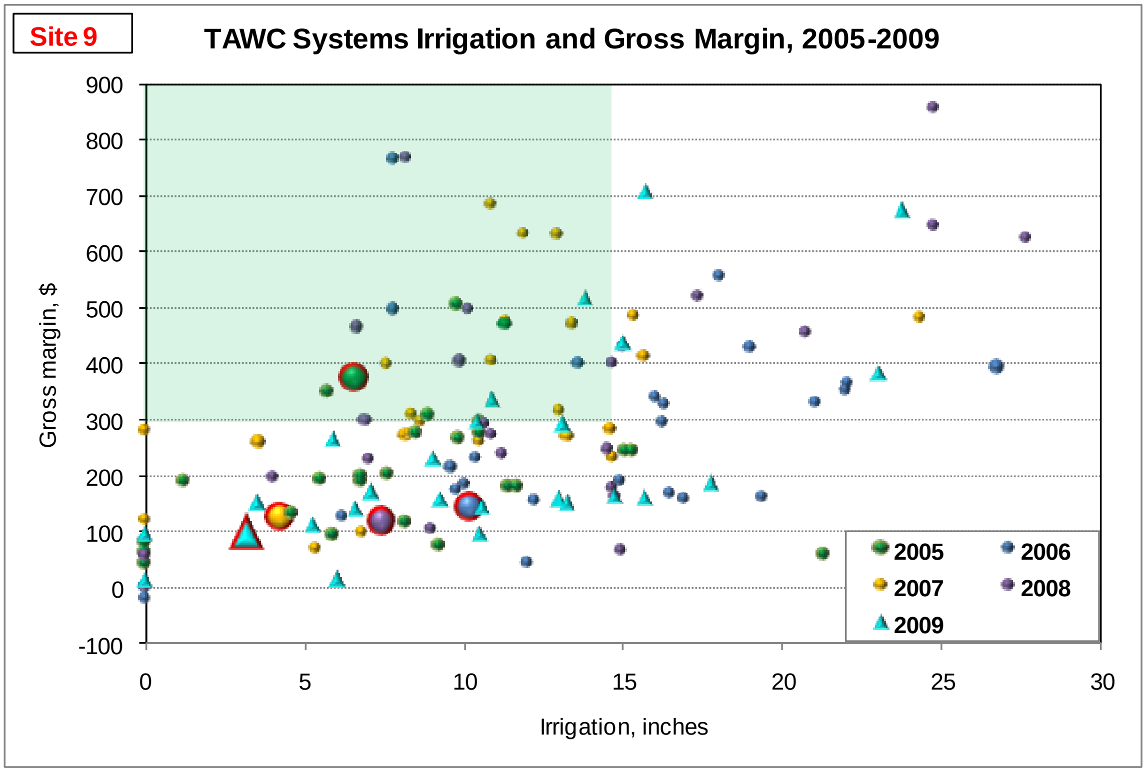
Comments: This site was returned to conventional tillage after eleven years of no-till production. Field 1 is predominantly kleingrass and used for cow/calf production. Field 2 was planted to cotton on forty-inch centers.

System 9

	Livestock	Field 1	Field 2
2005	Stocker steers	Klein/Buffalo/Blue grama/Annual forb mix interseeded with Rye for grazing	Rye for grazing and cover crop followed by Cotton
2006	Stocker steers	Klein/Buffalo/Blue grama/Annual forb mix interseeded with Rye for grazing	Cotton following Rye cover crop
2007	Stocker heifers	Klein/Buffalo/Blue grama/Annual forb mix interseeded with Rye for grazing	Grain Sorghum following Rye cover crop
2008	Cow-calf	Klein/Buffalo/Blue grama/Annual forb mix for grazing	Cotton
2009	None	Klein/Buffalo/Blue grama/Annual forb mix for grazing	Cotton

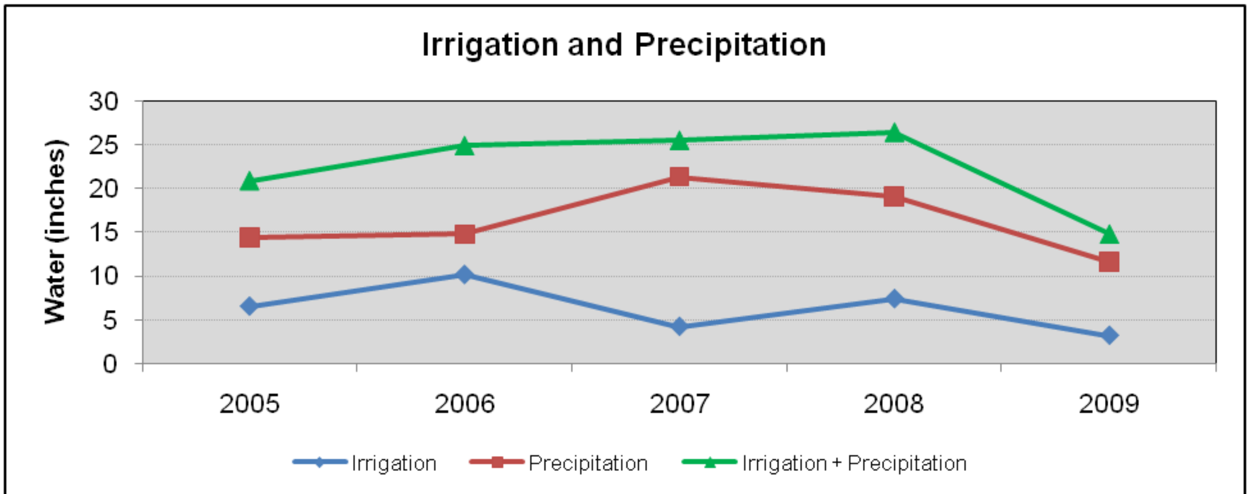

Site 9, Field 1 (April, 2009)

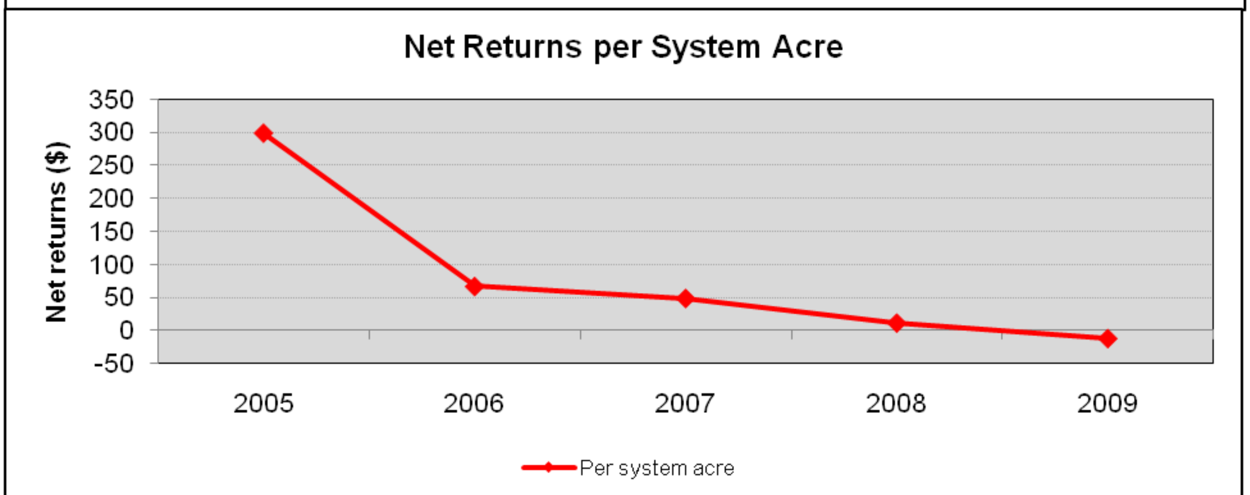

Site 9, Field 2 (April, 2009)

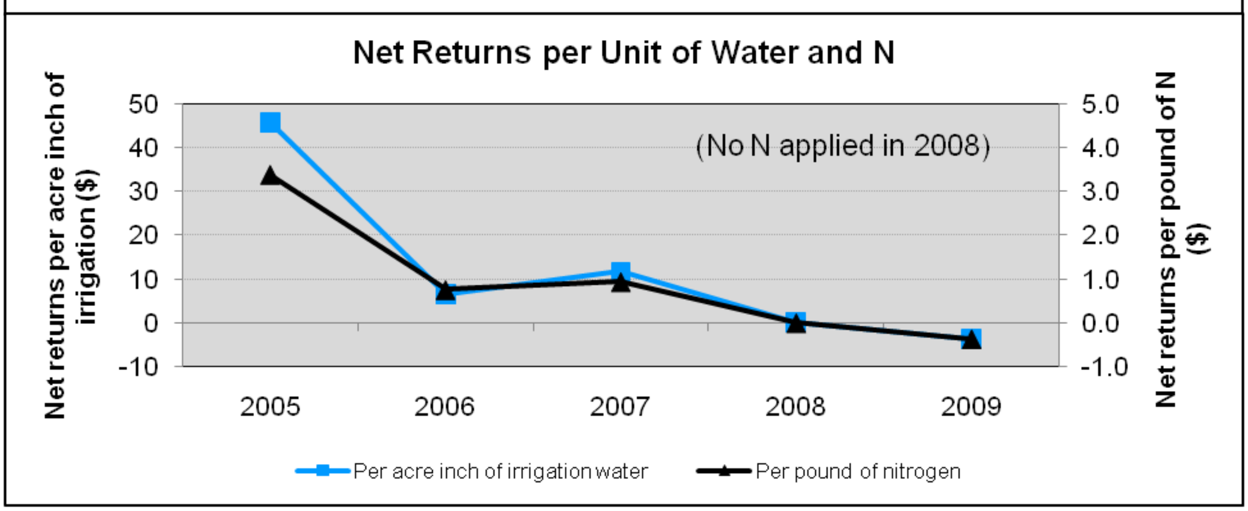


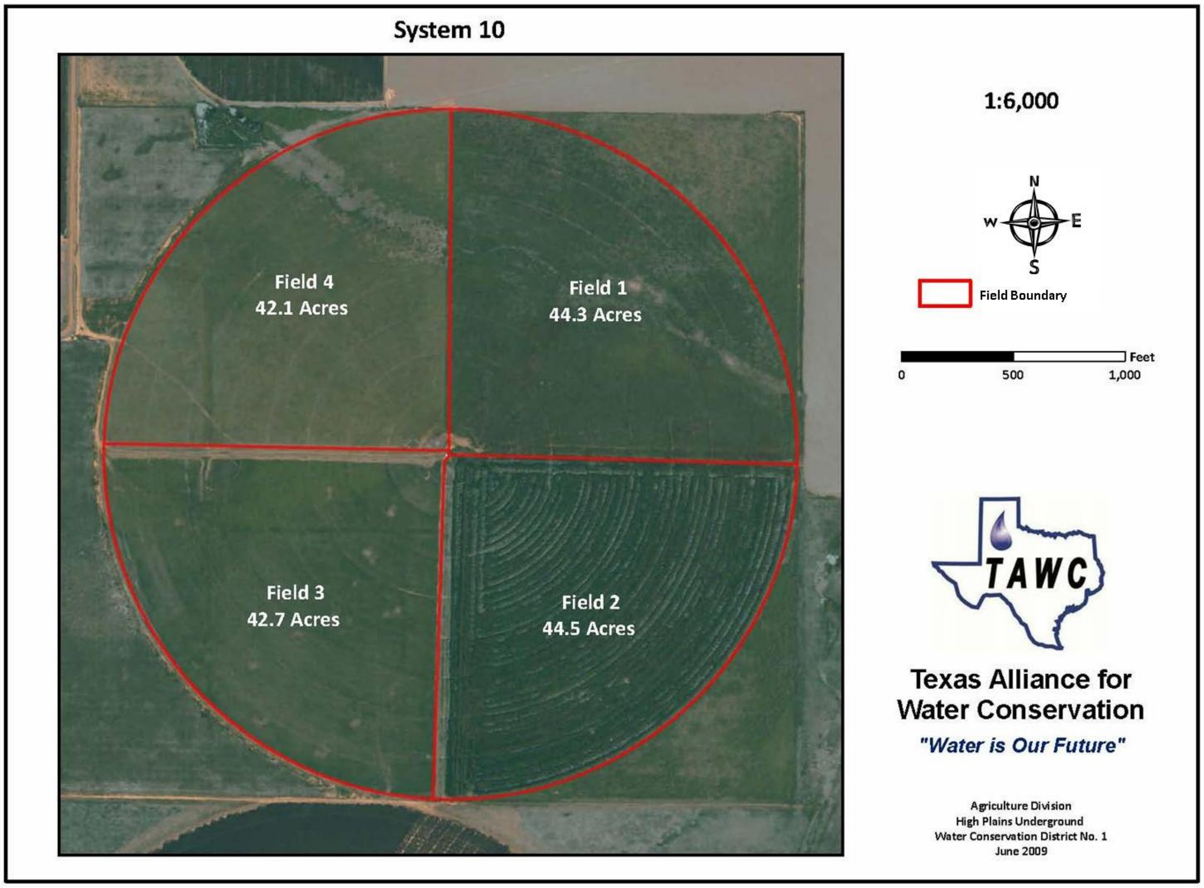
Site 9
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 9


Irrigation and Precipitation
Water (inches)
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
350
300
250
200
150
100
50
0
-50
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
-10
(No N applied in 2008)
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 10 Description

Total system acres: 173.6

Field No. 1 Acres: 44.3
Major soil type: Pullman clay loam; 0 to 1% slope
Lofton clay loam; 0 to 1% slope
Estacado clay loam; 0 to 1% slope

Field No. 2 Acres: 44.5
Major soil type: Pullman clay loam; 0 to 1% slope
Estacado clay loam; 0 to 1% slope

Field No. 3 Acres: 42.7
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 4 Acres: 42.1
Major soil type: Pullman clay loam; 0 to 1 and 1 to 3% slope
Lofton clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 800

Number of wells: 2

Fuel source: Electric

Comments: This is a four cell, pivot irrigated forage/livestock system. Two cells are planted to Old-world bluestem and one cell is planted to Bermuda grass. The fourth cell was planted to cotton on forty-inch centers.

System 10

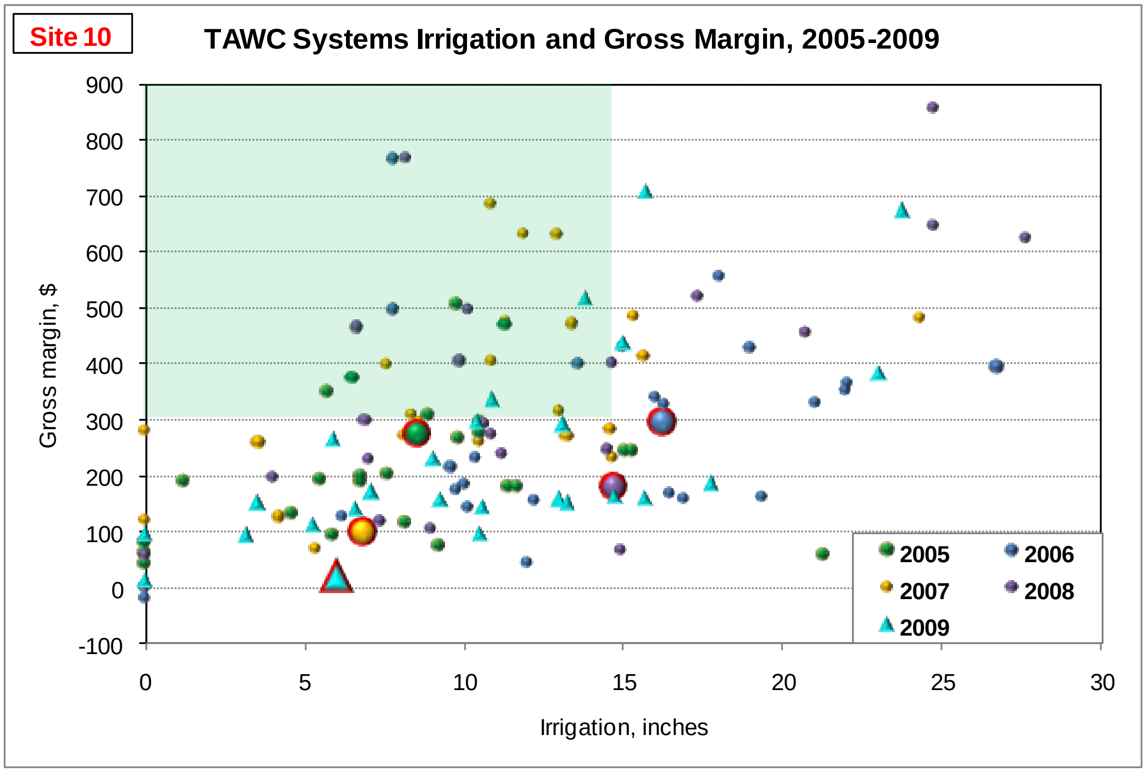
	Livestock	Field 1	Field 2	Field 3	Field 4
2005	Cow-calf	Dahl planted, no grazing this year	Cotton	Dahl for grazing and hay	Bermudagrass planted, some grazing
2006	Cow-calf	Dahl for grazing	Oats for hay followed by Forage Sorghum for hay	Dahl for grazing	Bermudagrass for grazing and hay
2007	Cow-calf	Dahl for grazing	Corn for silage following Wheat cover crop	Dahl for grazing and seed	Bermudagrass for grazing
2008	Cow-calf	Dahl for grazing	Wheat for grain followed by Corn for grain	Dahl for grazing and hay	Bermudagrass for grazing
2009	Cow-calf	Dahl for grazing	Cotton	Dahl for grazing	Bermudagrass for grazing

Site 10, Field 1 (May 2009)

Site 10, Field 2 (July 2009)

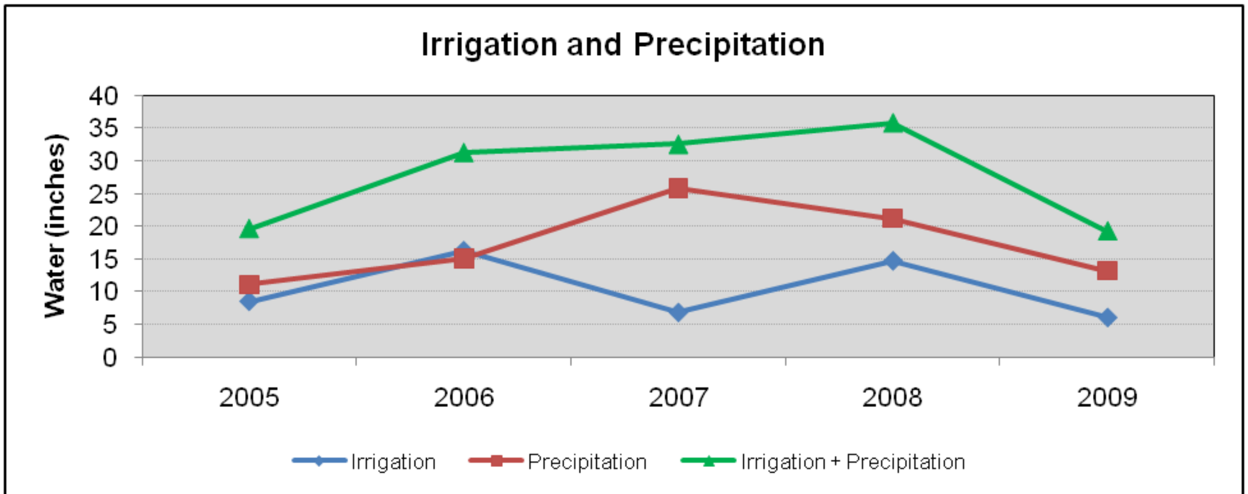
Site 10, Field 3 (October 2009)

Site 10, Field 4 (July 2009)

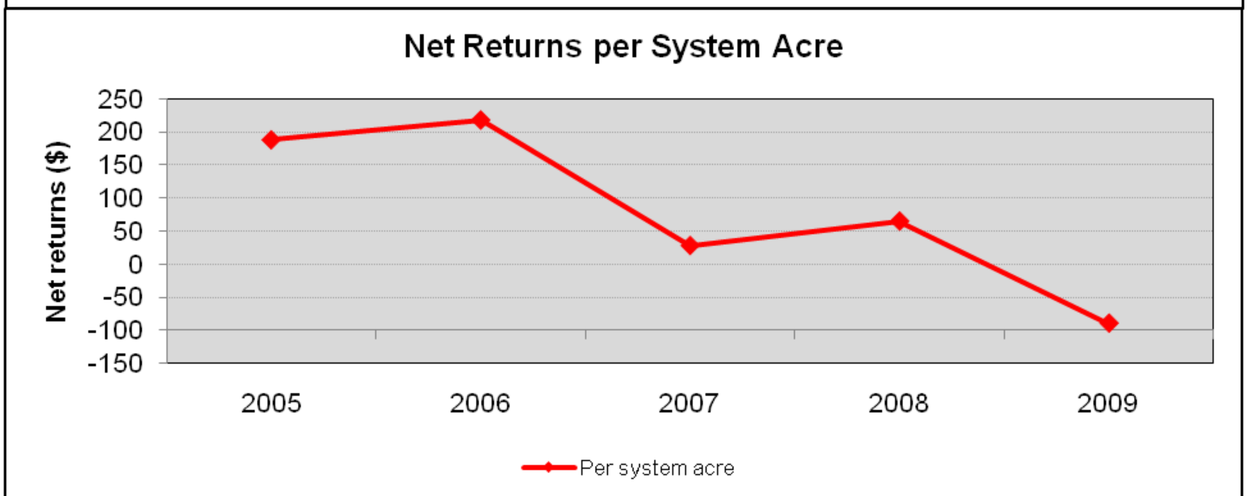


Site 10
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

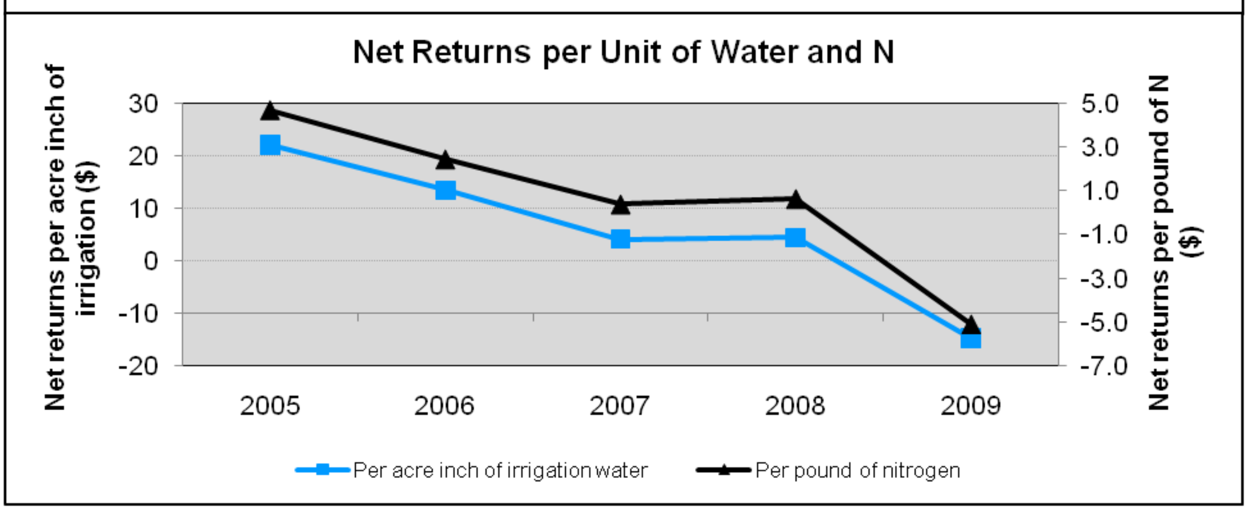
System 10



Irrigation and Precipitation
Water (inches)
0
5
10
15
20
25
30
35
40
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
-150
-100
-50
0
50
100
150
200
250
2005
2006
2007
2008
2009
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
-20
-10
0
10
20
30
Net returns per pound of N ($)
-7.0
-5.0
-3.0
-1.0
1.0
3.0
5.0
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen

System 11 Description

Total system acres: 92.5

Field No. 1 Acres: 45.2
Major soil type: Lofton clay loam; 0 to 1% slope
Olton clay loam; 1 to 3% slope

Field No. 2 Acres: 24.4
Major soil type: Pullman clay loam; 0 to 3% slope

Field No. 3 Acres: 22.9
Major soil type: Pullman clay loam; 0 to 3% slope

Irrigation

Type: Furrow

Pumping capacity, gal/min: 490

Number of wells: 1

Fuel source: Electric

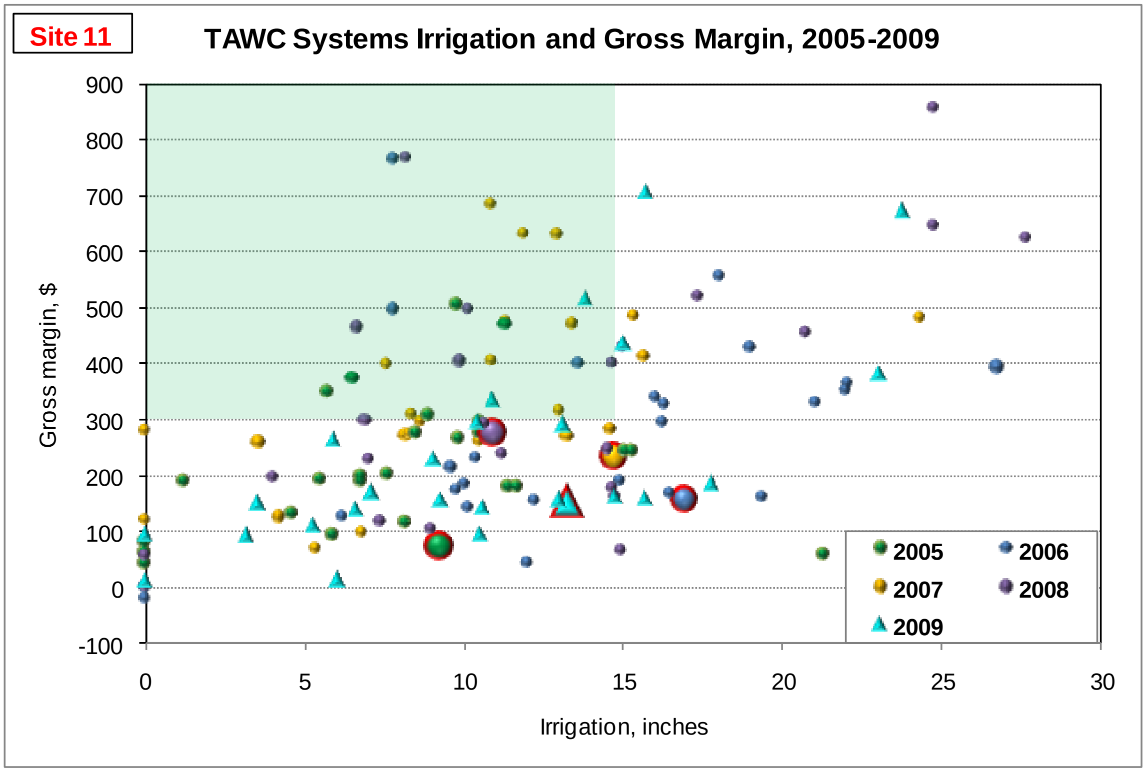
Comments: This is a furrow irrigated cotton/grain sorghum system using conventional tillage and planted on forty-inch centers.

System 11

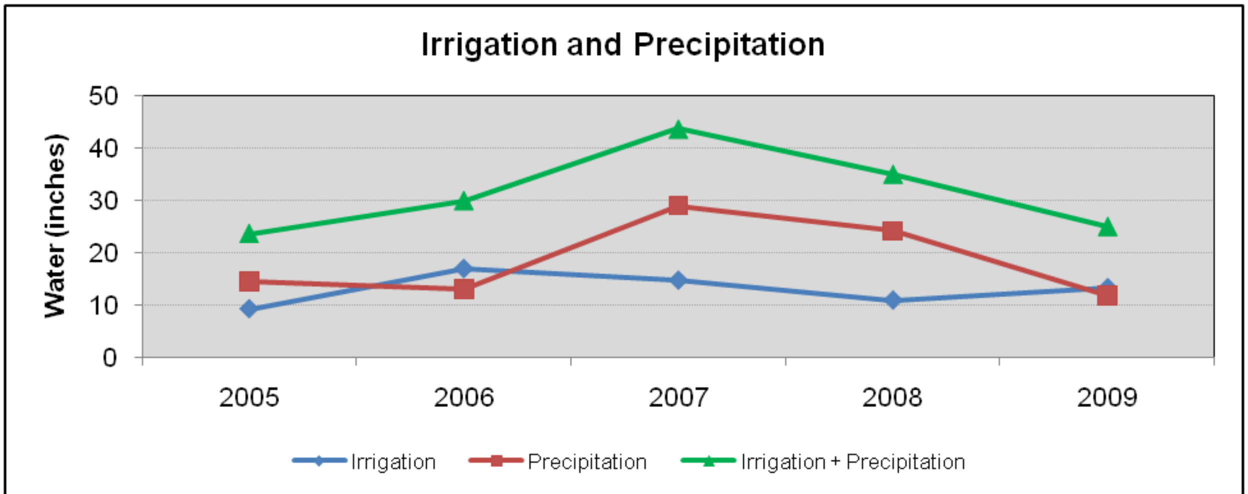
	Livestock	Field 1	Field 2	Field 3
2005	None	Cotton following Wheat cover crop	Cotton	Cotton
2006	None	Cotton	Cotton	Cotton
2007	None	Cotton	Cotton	Cotton
2008	None	Grain Sorghum	Cotton	Cotton
2009	None	Cotton	Grain sorghum	Cotton

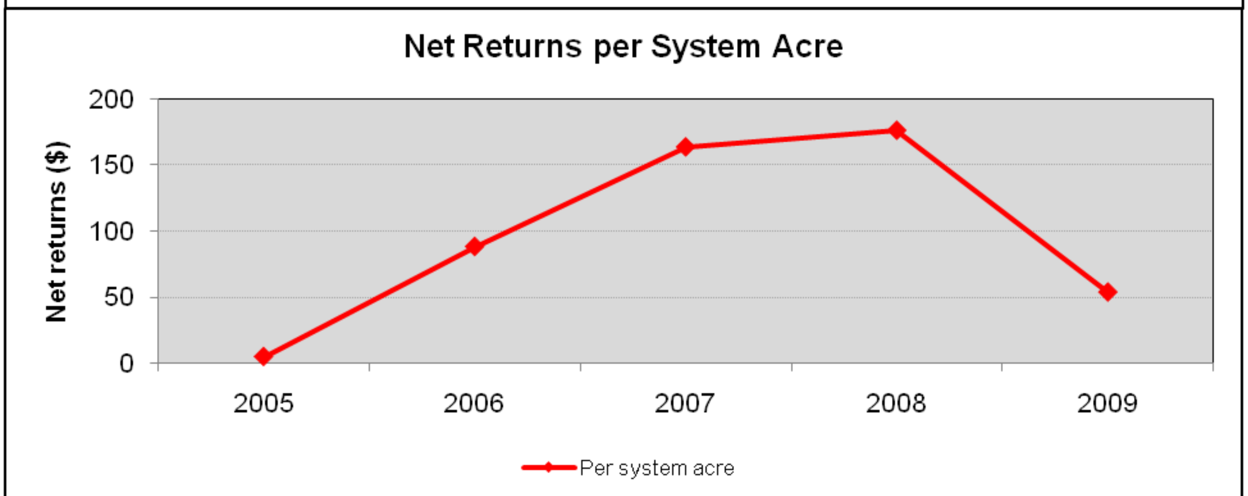
Site 11, Field 1 (July 2009)

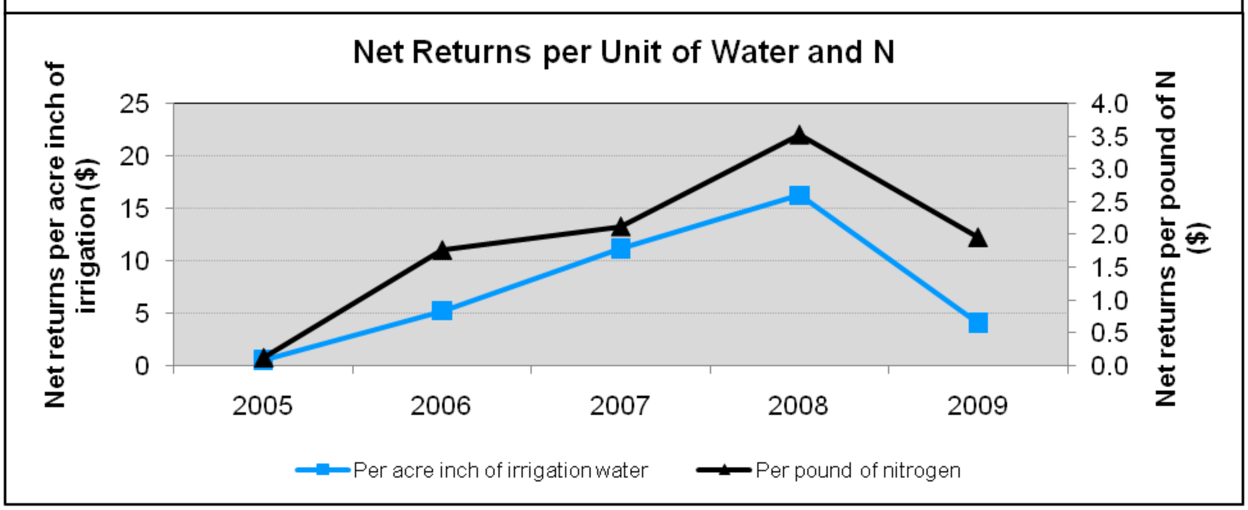
Site 11, Field 2 (July 2009)

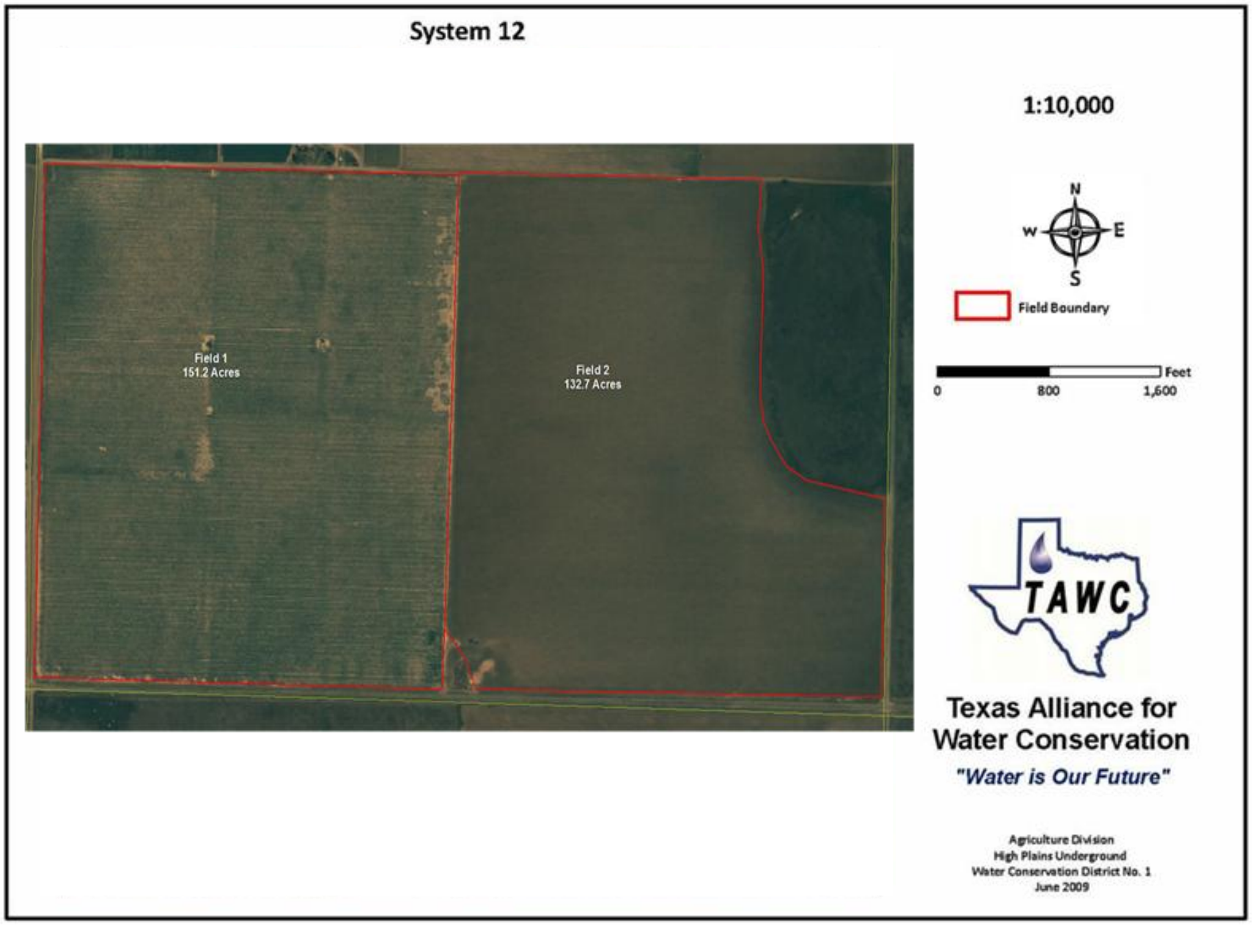

Site 11
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
Irrigation, inches
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
2005
2006
2007
2008
2009

System 11


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
200
150
100
50
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
25
20
15
10
5
0
Net returns per pound of N ($)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 12 Description

Total system acres: 283.9

Field No. 1 Acres: 151.2
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 132.7
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Dryland

Pumping capacity, gal/min:

Number of wells:

Fuel source:

Comments: This dryland system uses cotton, grain sorghum and wheat in rotation. Grain sorghum was planted on old cotton ground. The balance of the acres was left fallow this year.

System 12

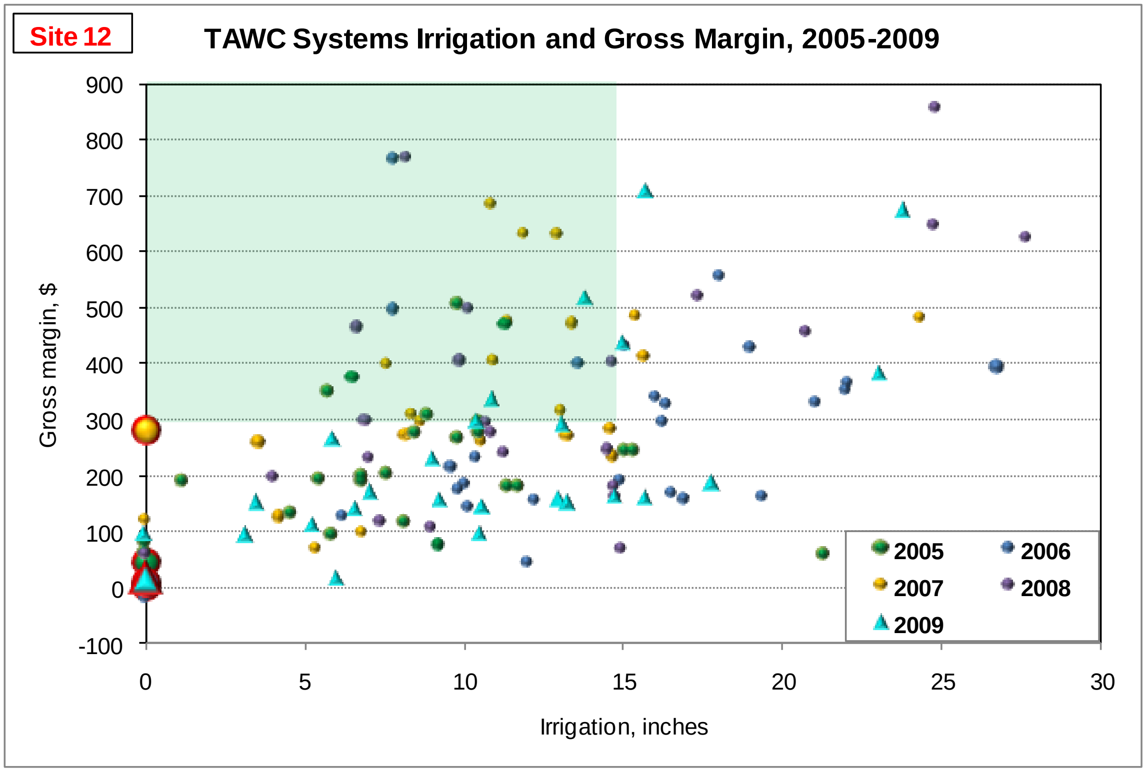
	Livestock	Field 1	Field 2
2005	None	Cotton following Wheat cover crop	Forage Sorghum for cover following Wheat
2006	None	Wheat for grain	Cotton following previous year cover of Forage Sorghum
2007	None	Cotton	Grain Sorghum following Wheat cover crop
2008	None	Grain Sorghum for silage	Fallow, volunteer Wheat for cover crop
2009	None	Grain Sorghum for silage	Fallow


Site 12, Field 1 (May 2009)

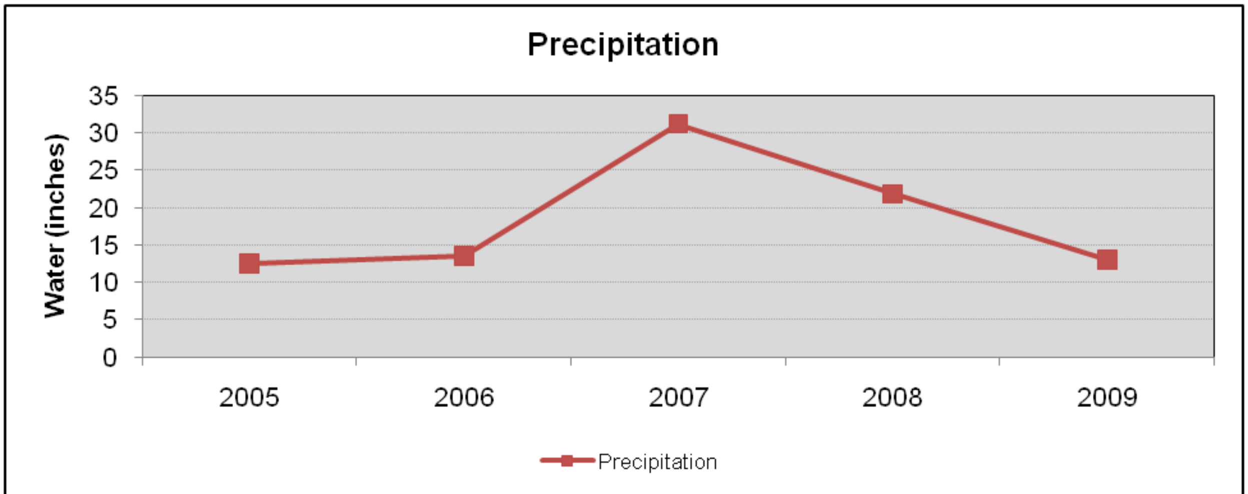

Site 12, Field 1 (July 2009)

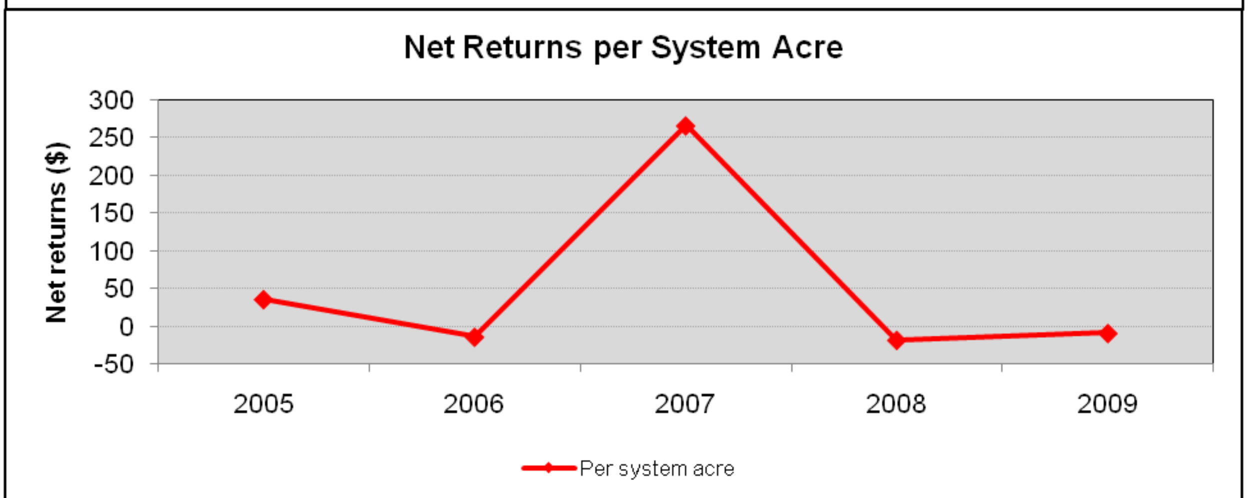

Site 12, Field 1 (October 2009)

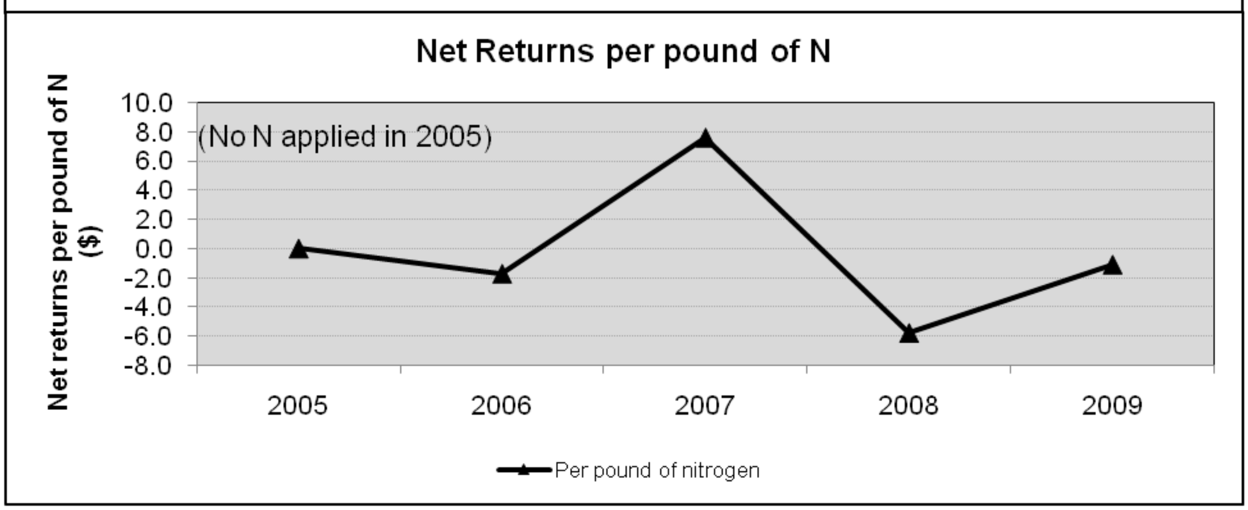

Site 12, Field 2 (March 2009)

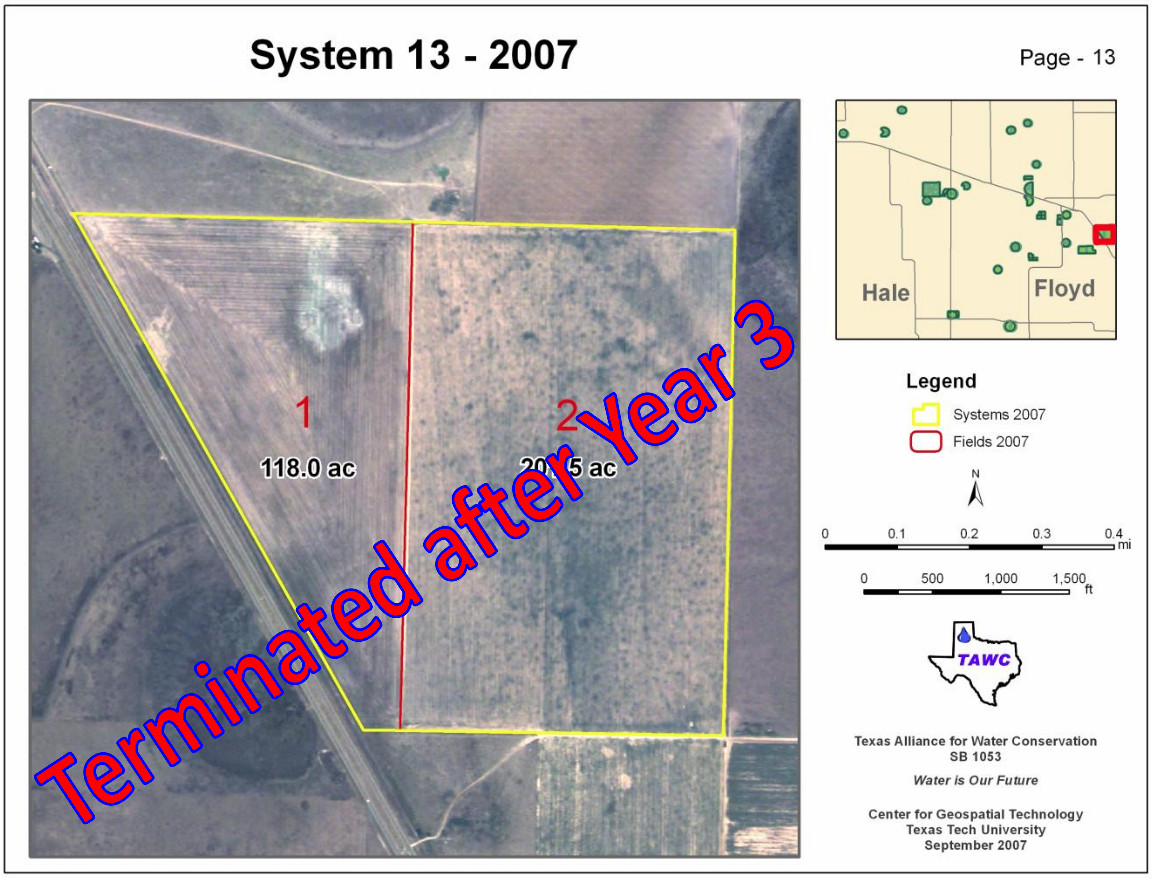

Site 12
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 12


Precipitation
Water (inches)
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
Precipitation


Net Returns per System Acre
Net returns ($)
300
250
200
150
100
50
0
-50
2005
2006
2007
2008
2009
Per system acre


Net Returns per pound of N
Net returns per pound of N ($)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
(No N applied in 2005)
2005
2006
2007
2008
2009
Per pound of nitrogen



System 13 Description

Total system acres: 319.5

Field No. 1 Acres: 118.0
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 201.5
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Dryland

Pumping capacity, gal/min:

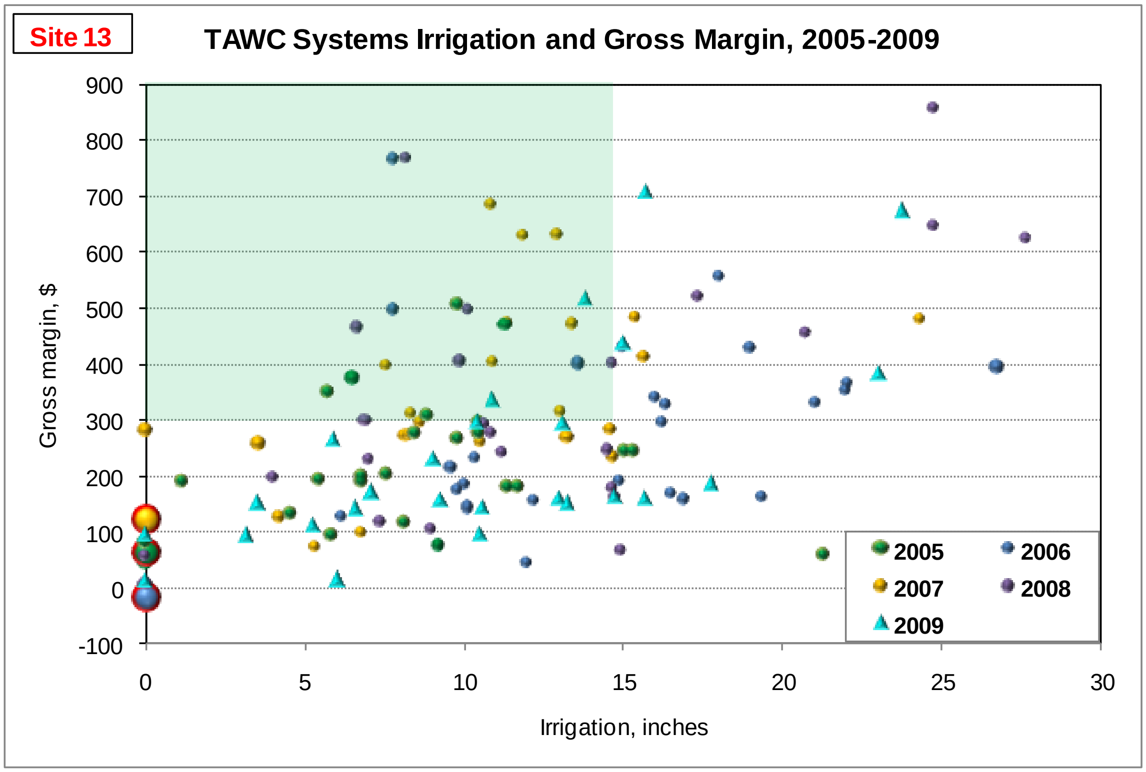
Number of wells:

Fuel source:

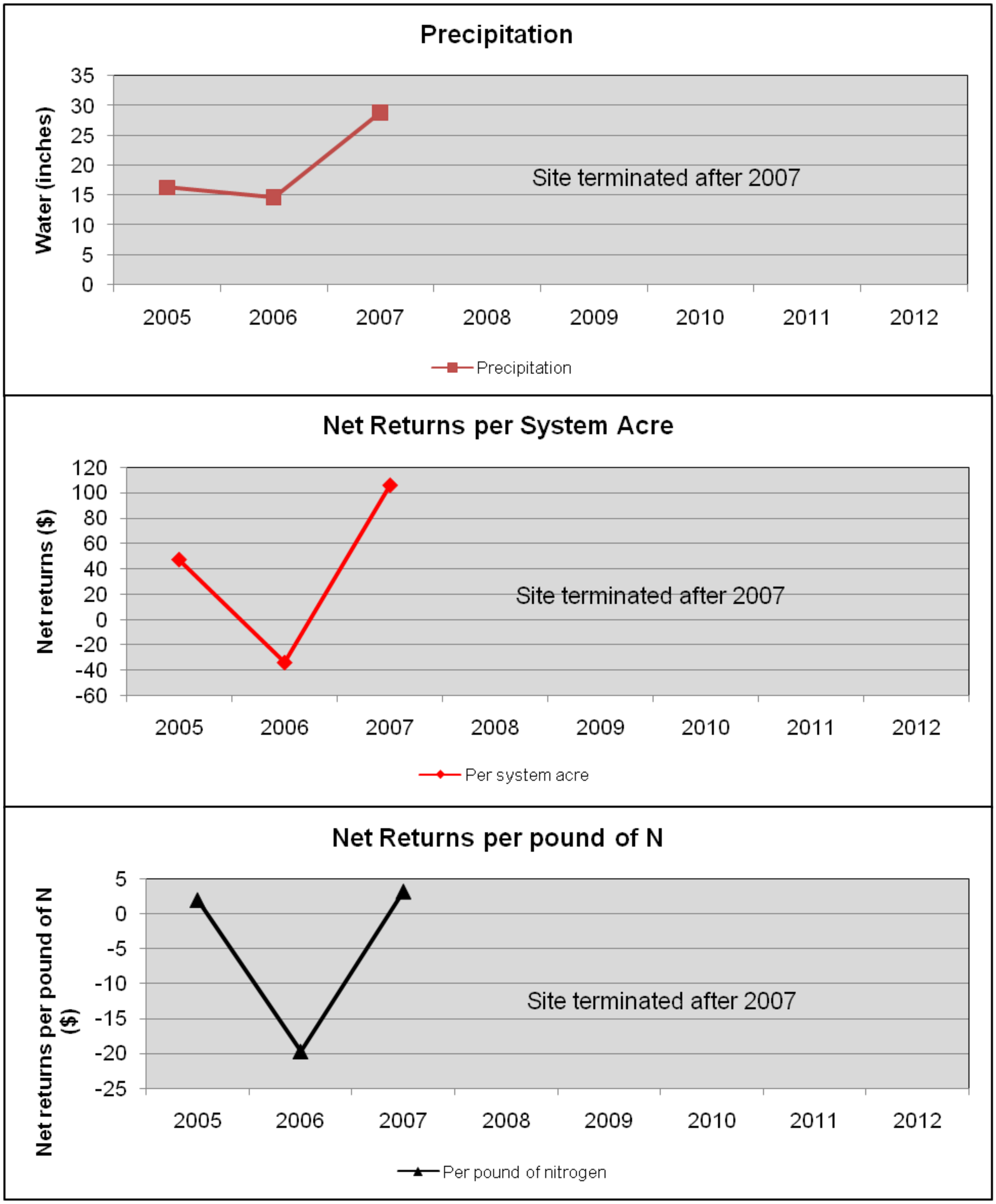
Comments: This dryland site uses cotton and small grains in rotation. Cotton is planted on forty-inch centers under limited tillage. Small grains are drilled after cotton harvest.

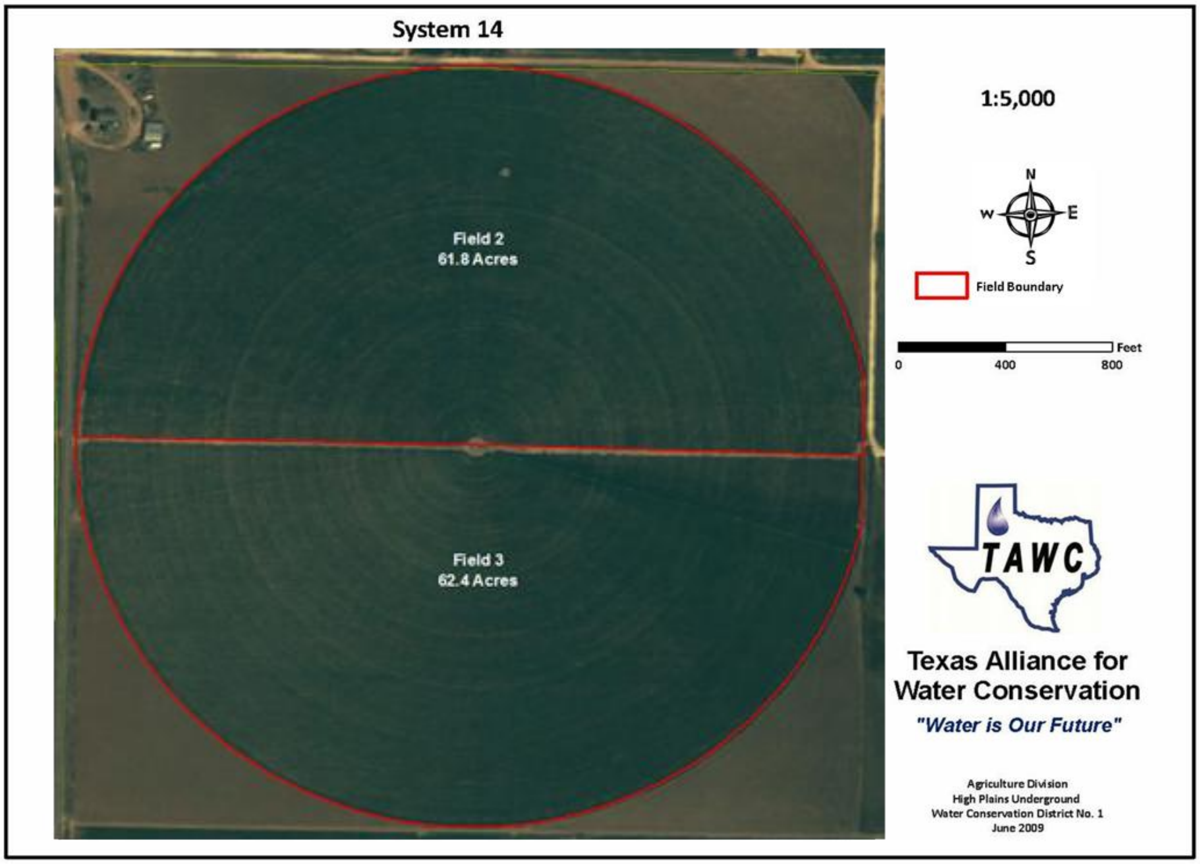
System 13

	Livestock	Field 1	Field 2
2005	None	Wheat for grain	Cotton following previous year's cover of Wheat stubble
2006	None	Cotton following previous year's cover of Wheat stubble	Wheat lost to drought
2007	None	Wheat for grain	Cotton following Wheat cover crop
2008	Site terminated for 2008		
2009			



System 13


Precipitation
Water (inches)
35
30
25
20
15
10
5
0
Site terminated after 2007
2005
2006
2007
2008
2009
2010
2011
2012
Precipitation
Net Returns per System Acre
Net returns ($)
120
100
80
60
40
20
0
-20
-40
-60
Site terminated after 2007
2005
2006
2007
2008
2009
2010
2011
2012
Per system acre
Net Returns per pound of N
Net returns per pound of N ($)
5
0
-5
-10
-15
-20
-25
Site terminated after 2007
2005
2006
2007
2008
2009
2010
2011
2012
Per pound of nitrogen



System 14 Description

Total system acres:	124.2
Field No. 2 Acres:	61.8
Major soil type:	Pullman clay loam; 0 to 1% slope
Field No. 3 Acres:	62.4
Major soil type:	Pullman clay loan; 0 to 1% slope

Irrigation

Type:	Center Pivot (LEPA)
Pumping capacity, gal/min:	300
Number of wells:	3
Fuel source:	Electric

Comments: This is a pivot irrigated cotton/wheat system with limited water. The producer uses conventional tillage on forty-inch centers.

System 14

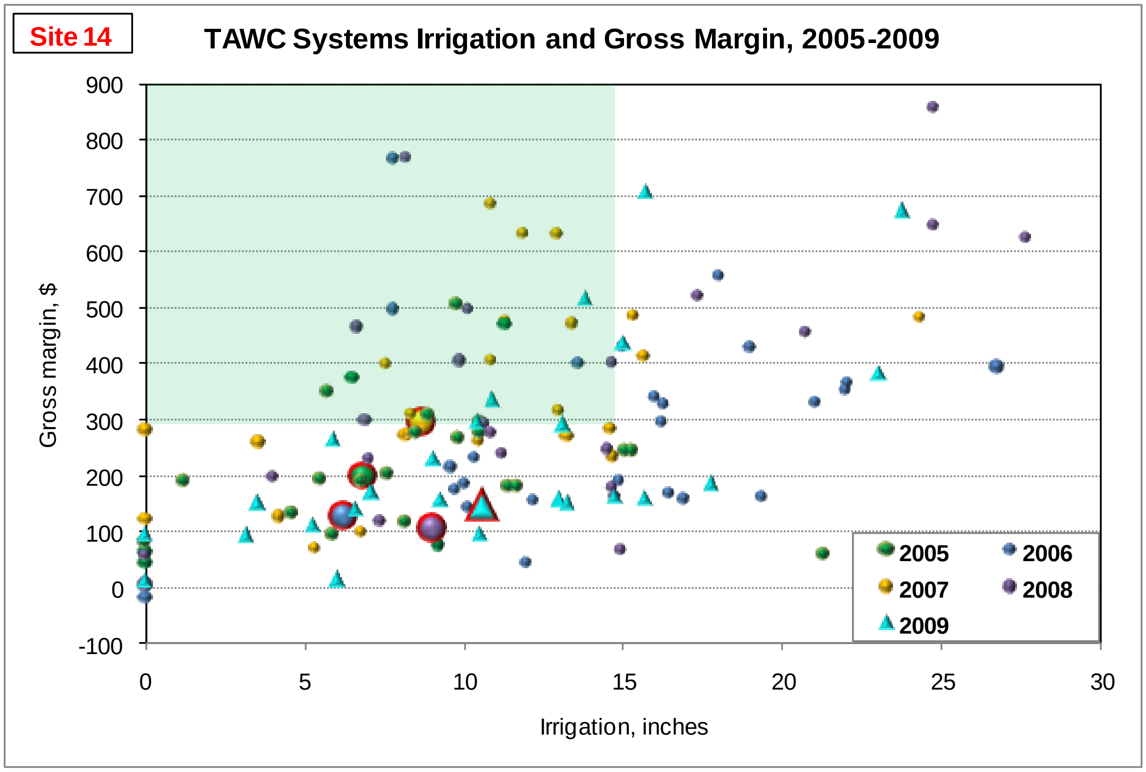
	Livestock	Field 1	Field 2	Field 3
2005	None	Cotton		
2006	None	Cotton		
2007	None	Cotton		
2008	None	Split into Fields 2 and 3	Cotton	Cotton
2009	None		Cotton	Wheat

Site 14, Field 2 (May 2009)

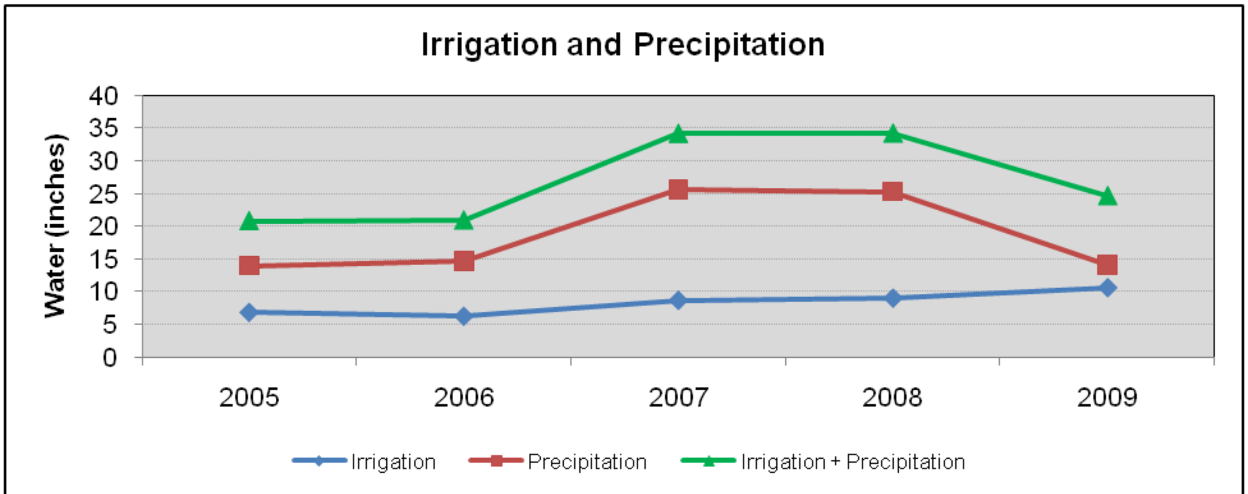
Site 14, Field 2 (July 2009)

Site 14, Field 2 (October 2009)

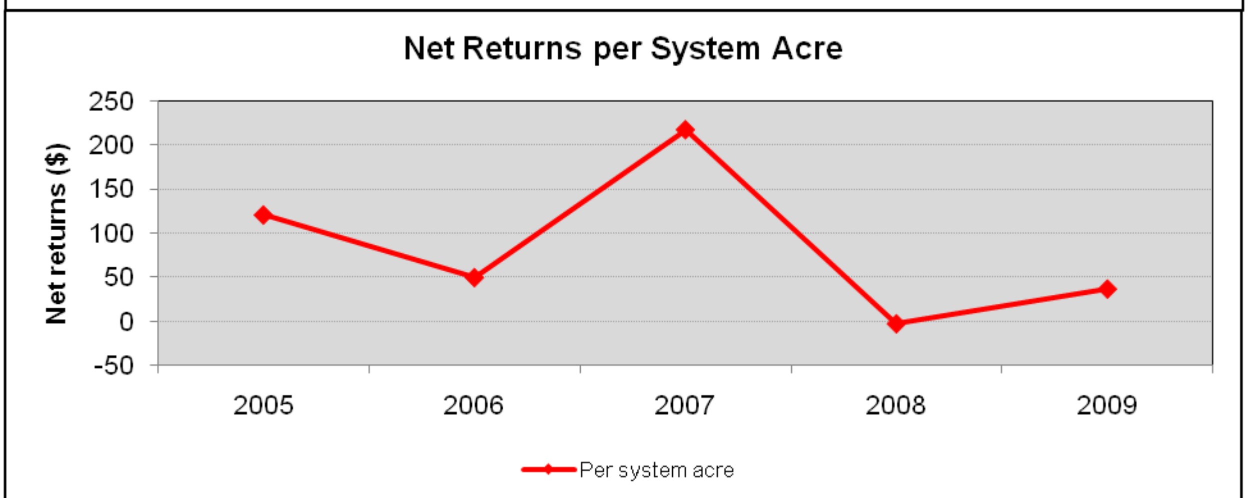
Site 14, Field 3 (May 2009)


Site 14
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

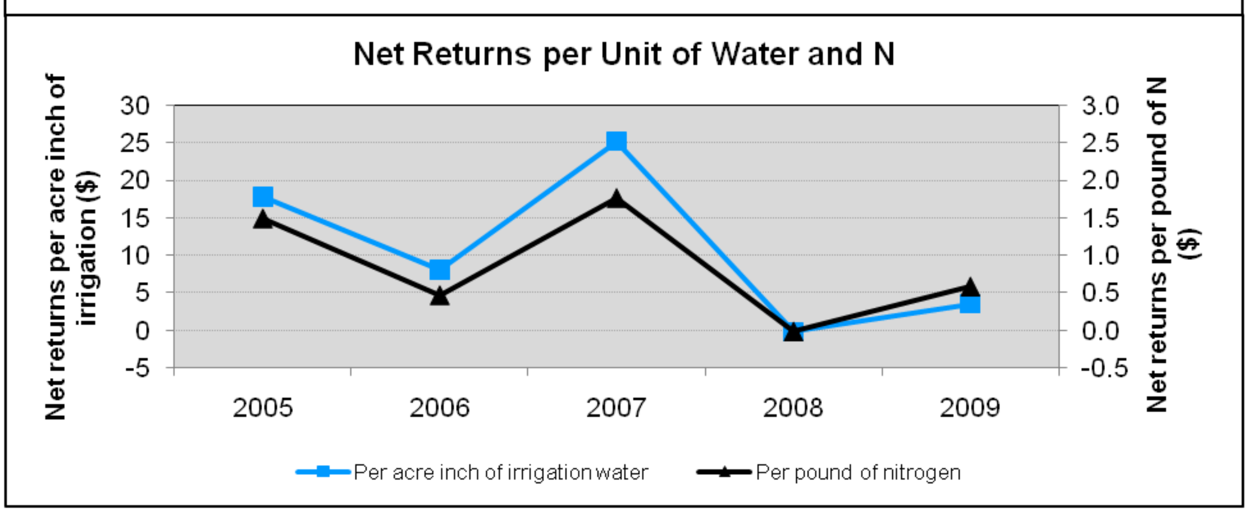
System 14



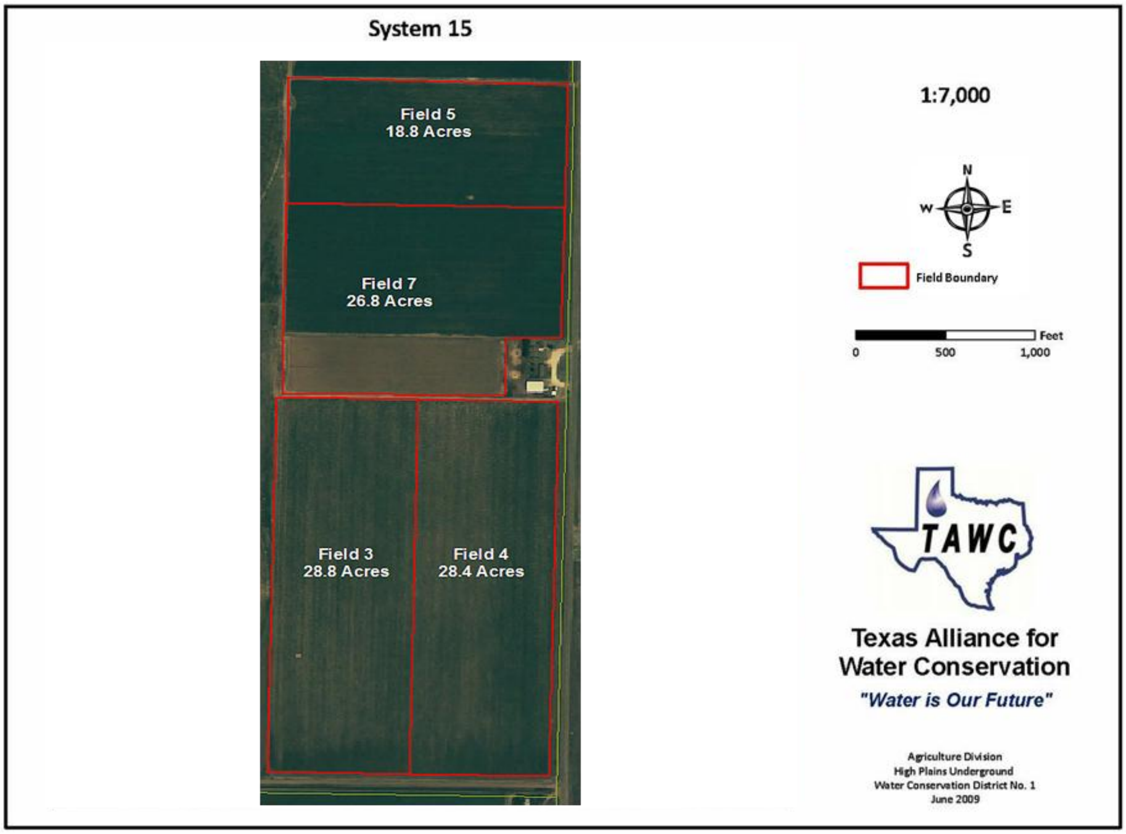
Irrigation and Precipitation
Water (inches)
40
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
250
200
150
100
50
0
-50
2005
2006
2007
2008
2009
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
30
25
20
15
10
5
0
-5
2005
2006
2007
2008
2009
Net returns per pound of N ($)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
Per acre inch of irrigation water
Per pound of nitrogen



System 15 Description

Total system acres: 102.8

Field No. 3 *2006-2009*
Acres: 28.8
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 4 *2006-2009*
Acres: 28.4
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 5 *2008-2009*
Acres: 18.8
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 6 *2008 only*
Acres: 19.4
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 7 *2009 only*
Acres: 26.8
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Furrow Fields 3 and 4
Subsurface Drip Fields 5 and 7

Pumping capacity, gal/min: 290

Number of wells: 1

Fuel source: Natural gas

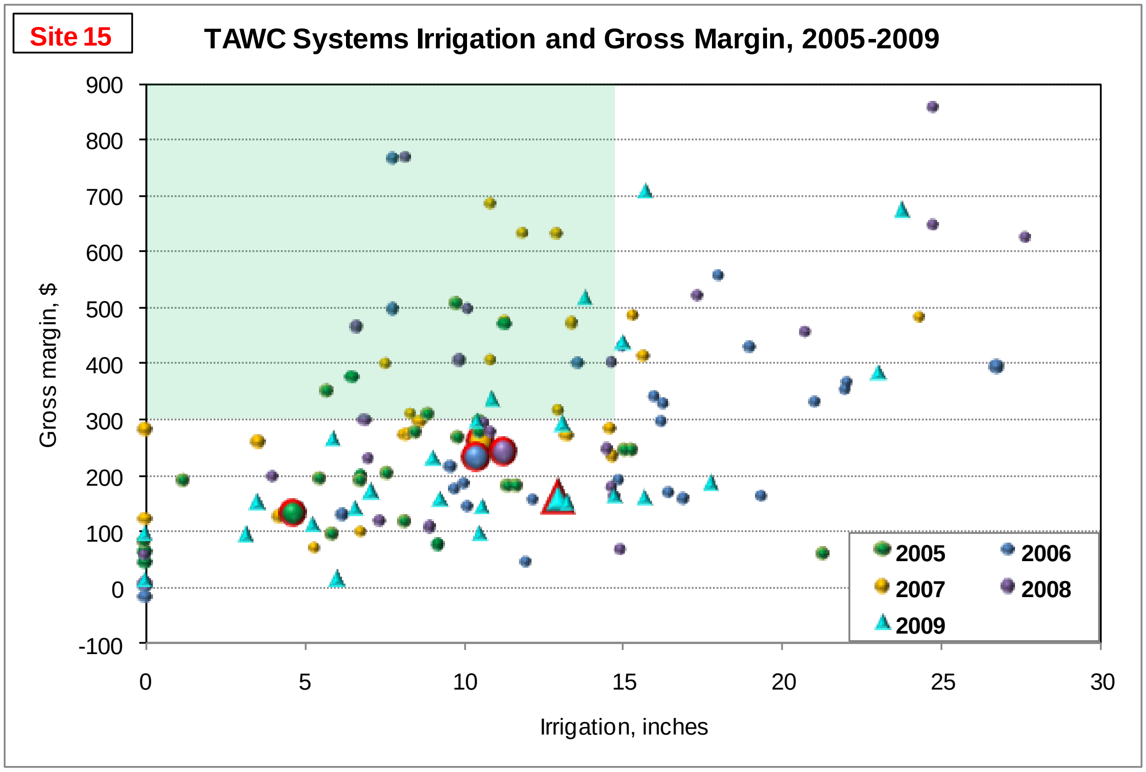
Comments: This has been a cotton/wheat/grain sorghum system in previous years. This year all fields were planted to cotton on forty-inch centers. A portion of the farm is drip irrigated with the balance using furrow irrigation.

System 15

	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7
2005	None	Cotton	Cotton					
2006	None	Cotton	Split into Fields 3 and 4	Cotton	Grain Sorghum			
2007	None	Cotton		Grain Sorghum	Cotton			
2008	None	Split into Fields 5 and 6		Cotton	Wheat harvested, volunteer Wheat for cover crop, replanted to Wheat	Cotton	Cotton	
2009	None			Cotton	Cotton	Cotton	Acres added to become Field 7	Cotton

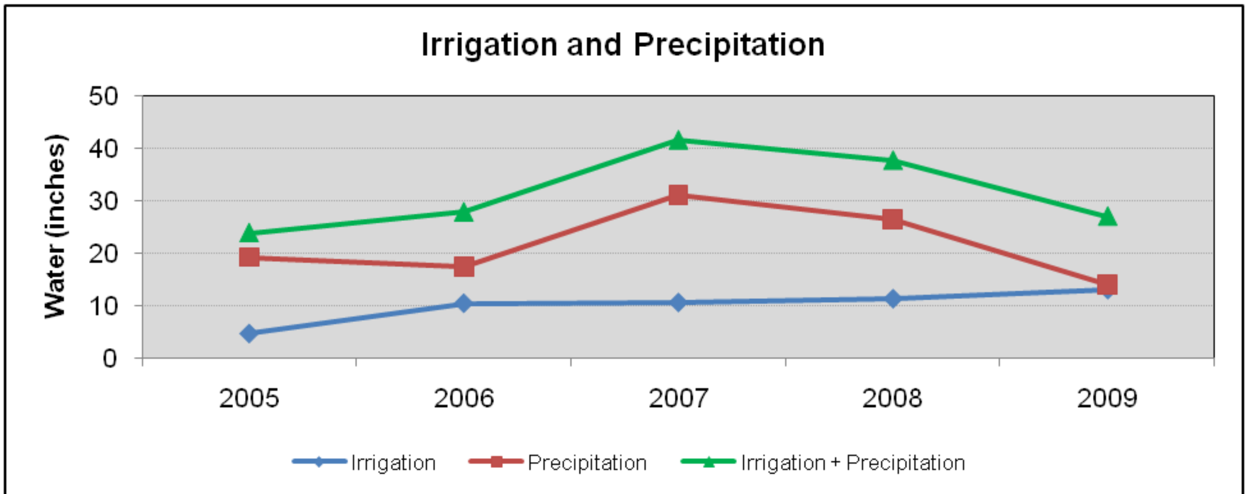
Site 15, Field 7 (April 2009)

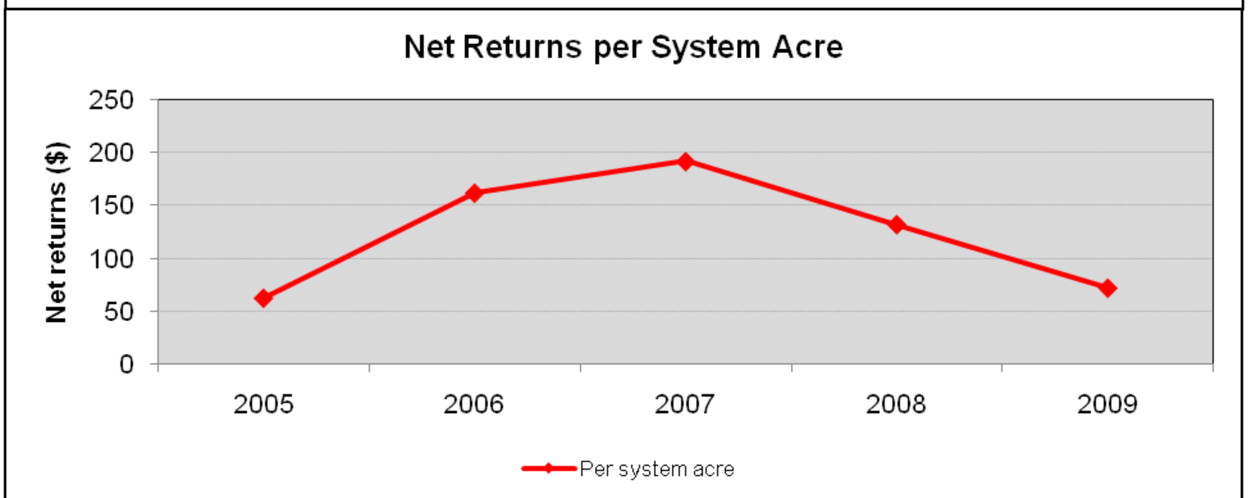
Site 15, Field 4 (May 2009)

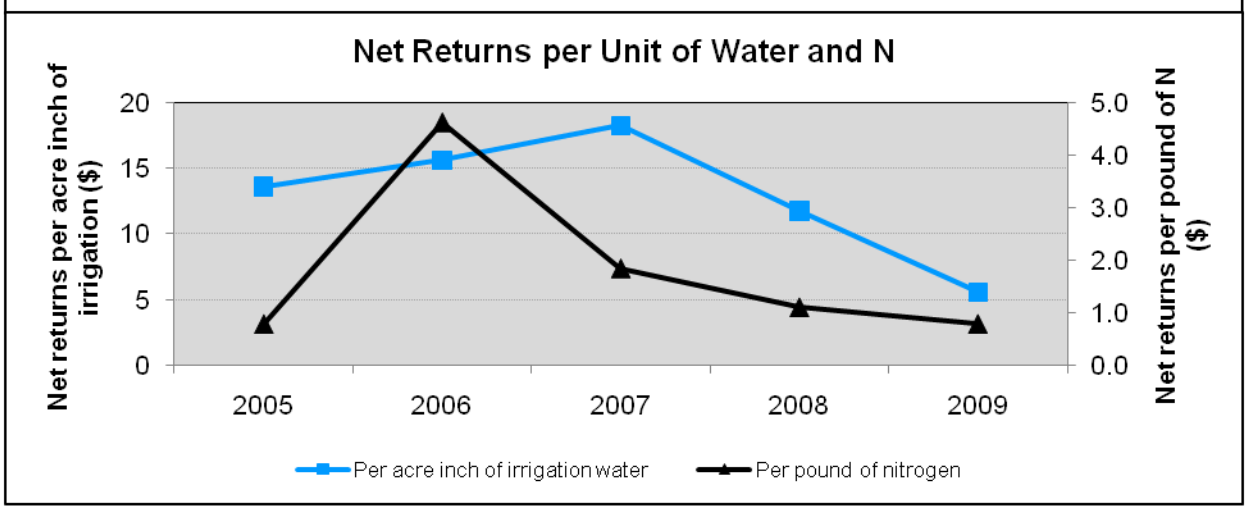


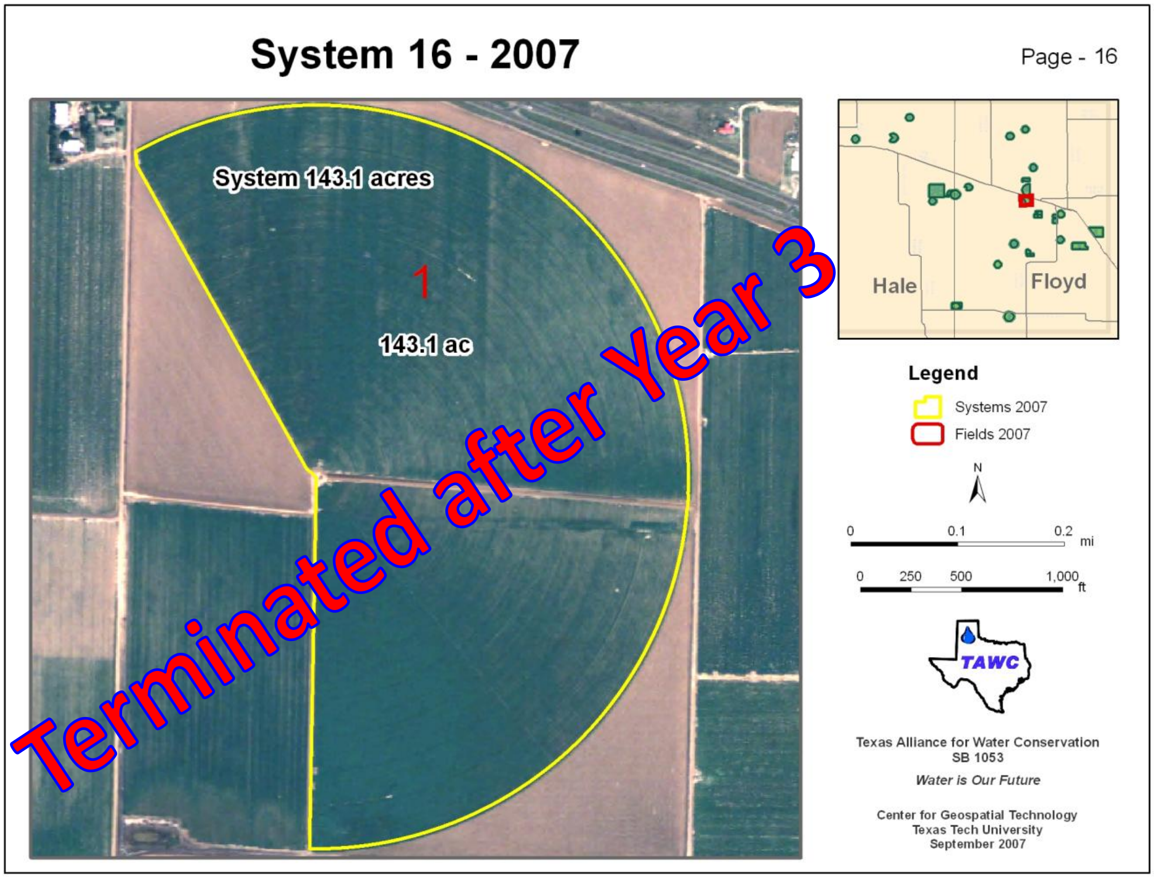
Site 15
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 15


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
250
200
150
100
50
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
20
15
10
5
0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 16 Description

Total system acres: 143.1

Field No. 1 Acres: 143.1
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 600

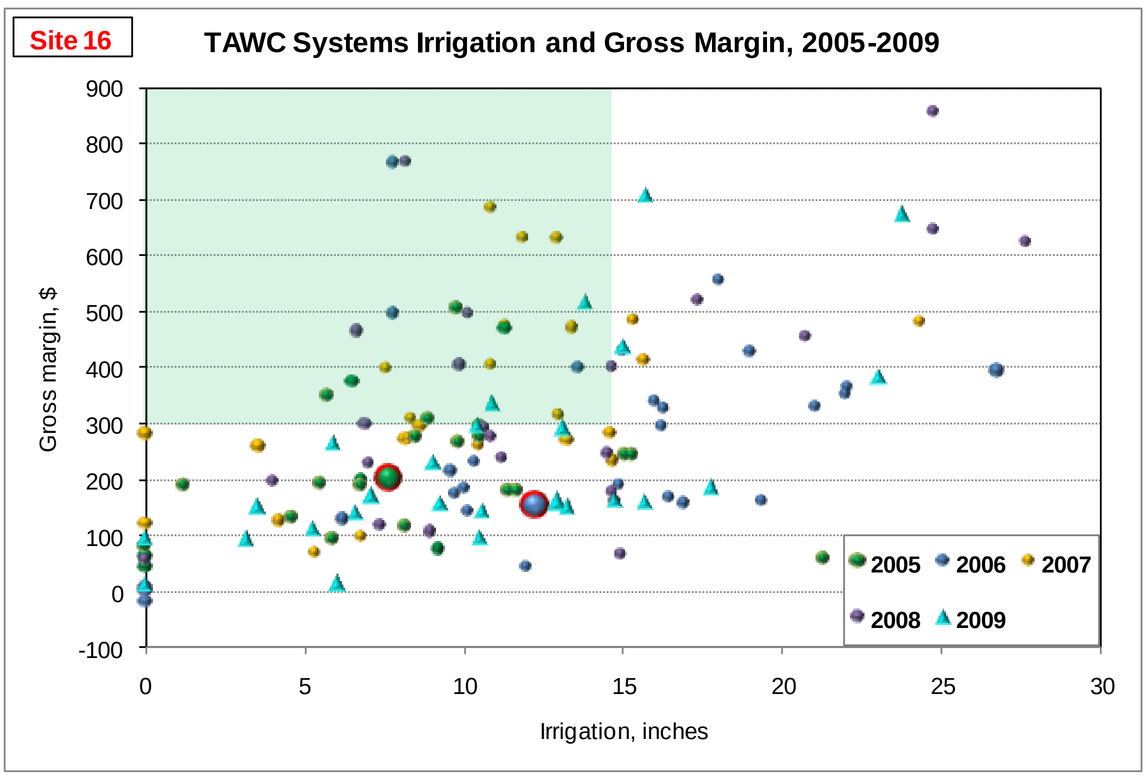
Number of wells: 3

Fuel source: Electric

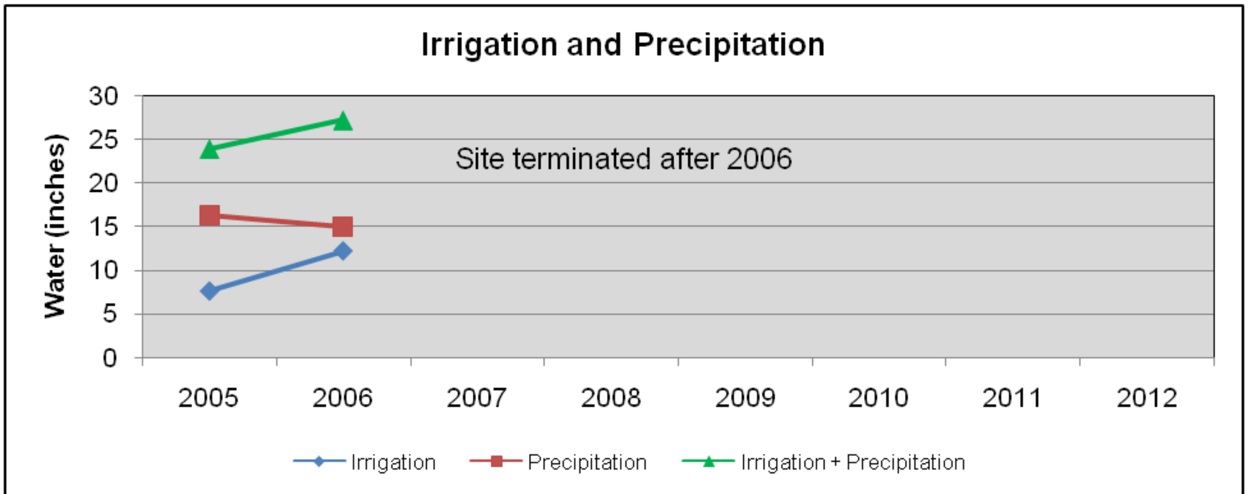
Comments: This pivot irrigated cotton site uses conventional tillage and plants on forty-inch centers.

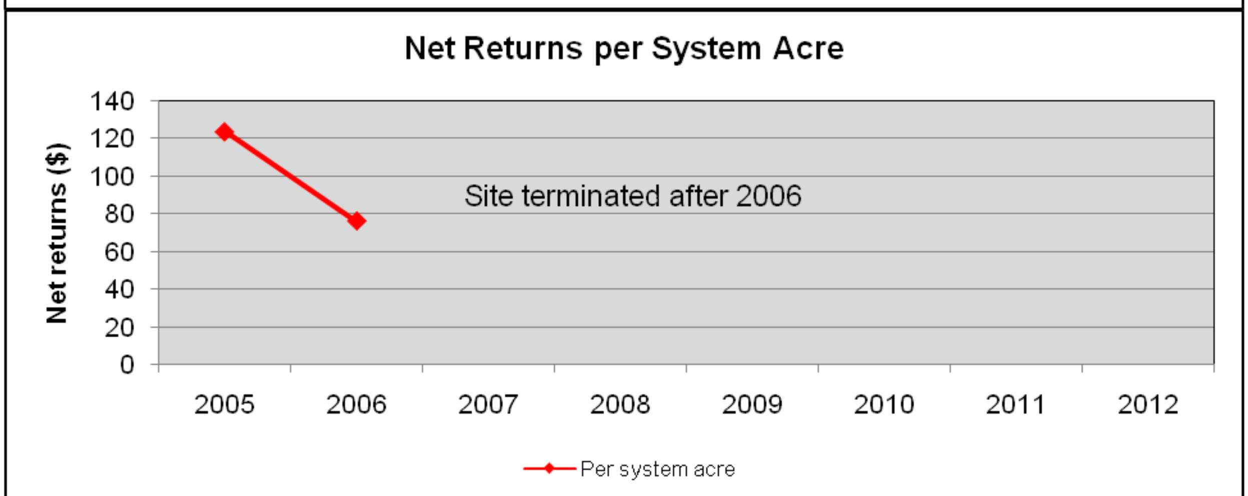
System 16

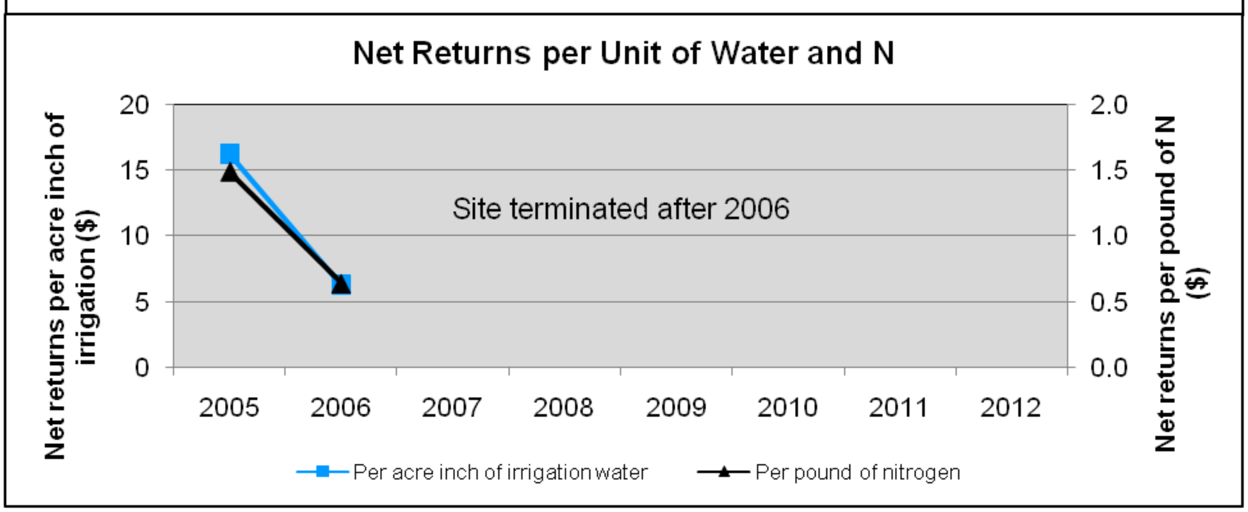
	Livestock	Field 1
2005	None	Cotton
2006	None	Cotton
2007	None	Cotton following Wheat cover crop
2008	Site terminated for 2008	
2009		

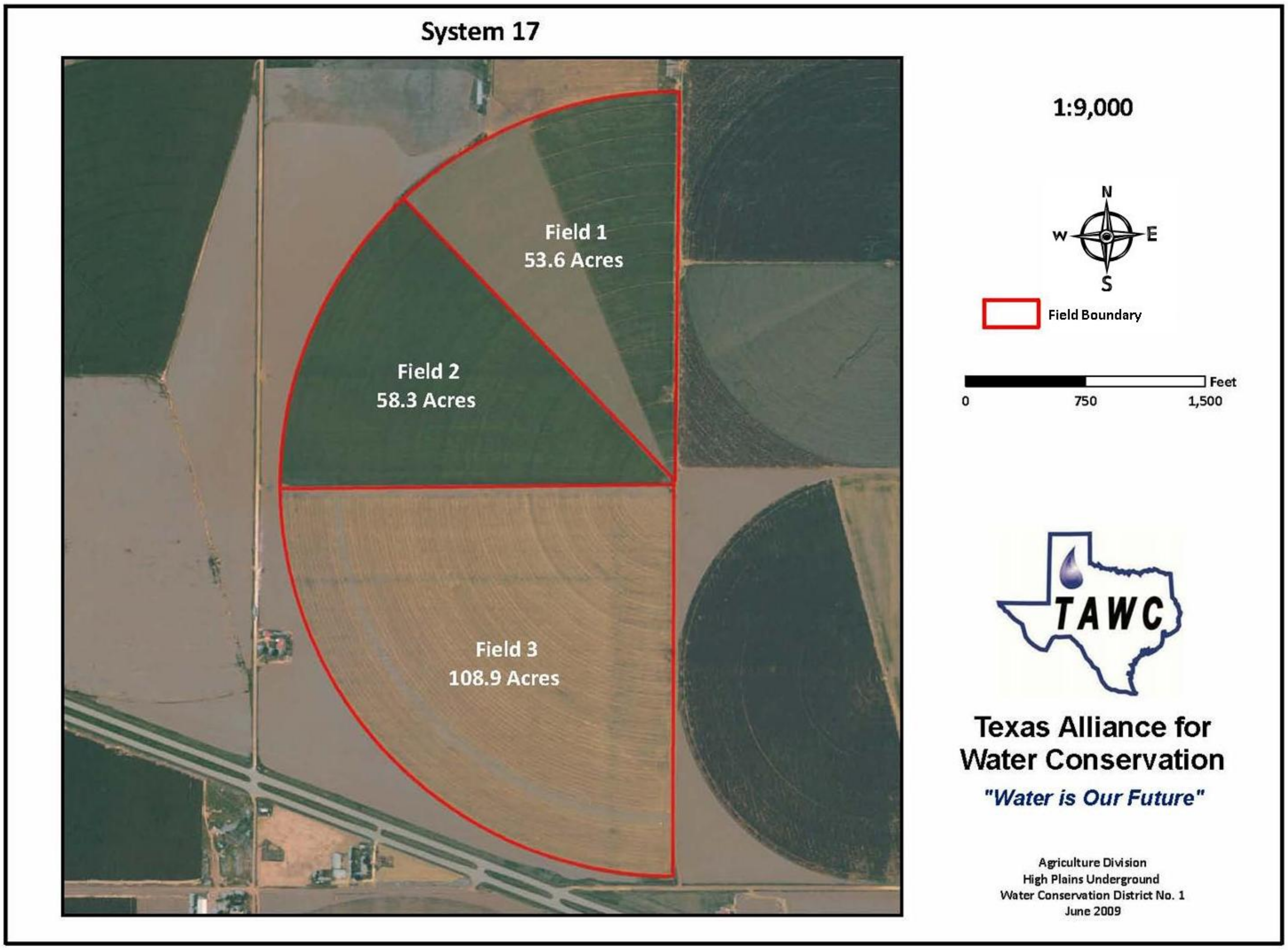


System 16


Irrigation and Precipitation
Water (inches)
30
25
20
15
10
5
0
Site terminated after 2006
2005
2006
2007
2008
2009
2010
2011
2012
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
140
120
100
80
60
40
20
0
Site terminated after 2006
2005
2006
2007
2008
2009
2010
2011
2012
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
20
15
10
5
0
Site terminated after 2006
2.0
1.5
1.0
0.5
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
2010
2011
2012
Per acre inch of irrigation water
Per pound of nitrogen



System 17 Description

Total system acres: 220.8

Field No. 1 Acres: 53.6
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 58.3
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 3 Acres: 108.9
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (MESA)

Pumping capacity, gal/min: 900

Number of wells: 8

Fuel source: Electric

Comments: This pivot site has grown cotton, corn, sunflowers and Old-World bluestem. Corn and sunflowers are planted on twenty-inch centers with cotton planted on thirty-inch centers. The Old-World bluestem is used for grazing and / or seed production.

System 17

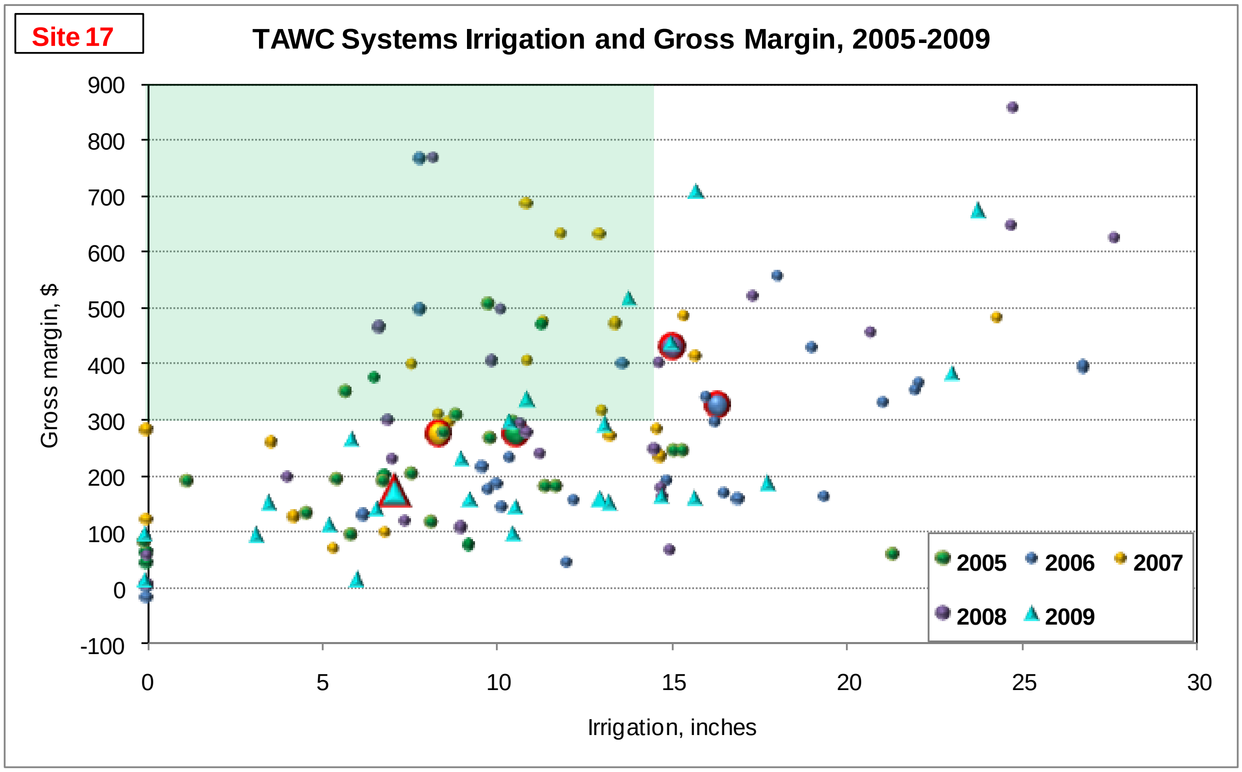
	Livestock	Field 1	Field 2	Field 3
2005	None	WW-B. Dahl grass for hay	Corn for silage, followed by wheat for grazing and cover	Cotton following cover crop of Wheat
2006	Cow-calf	WW-B. Dahl grass for grazing and hay	Wheat for grazing and cover followed by Cotton	Corn for silage, followed by Wheat for grazing and cover
2007	Cow-calf	WW-B. Dahl grass for grazing and seed	WW-B. Dahl grass for grazing, hay, seed, established after Wheat cover crop	Wheat for grazing and cover followed by Cotton
2008	Cow-calf	WW-B. Dahl grass for grazing and seed	WW-B. Dahl grass for grazing and seed	Corn for grain and grazing of residue
2009	Cow-calf	WW-B. Dahl grass for grazing and seed	WW-B. Dahl for grazing	Sunflowers


Site 17, Field 1 (April 2009)

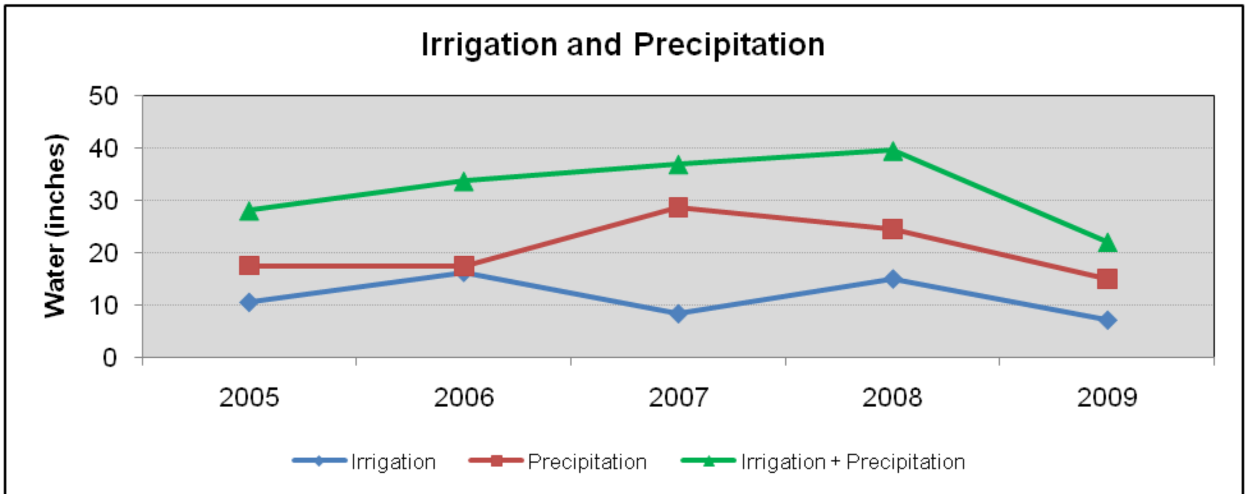

Site 17, Field 1 (October 2009)

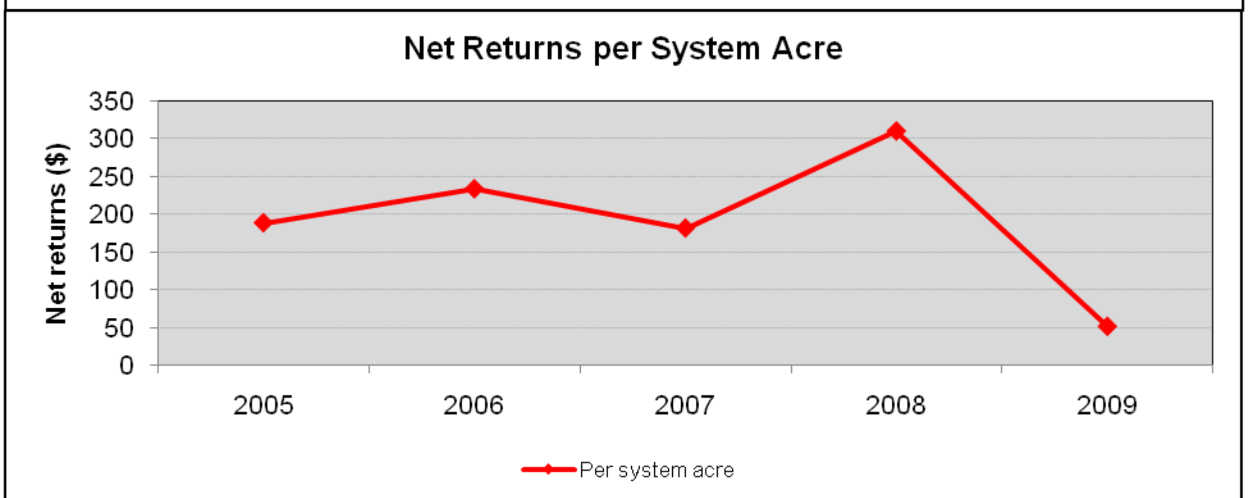

Site 17, Field 2 (September 2009)

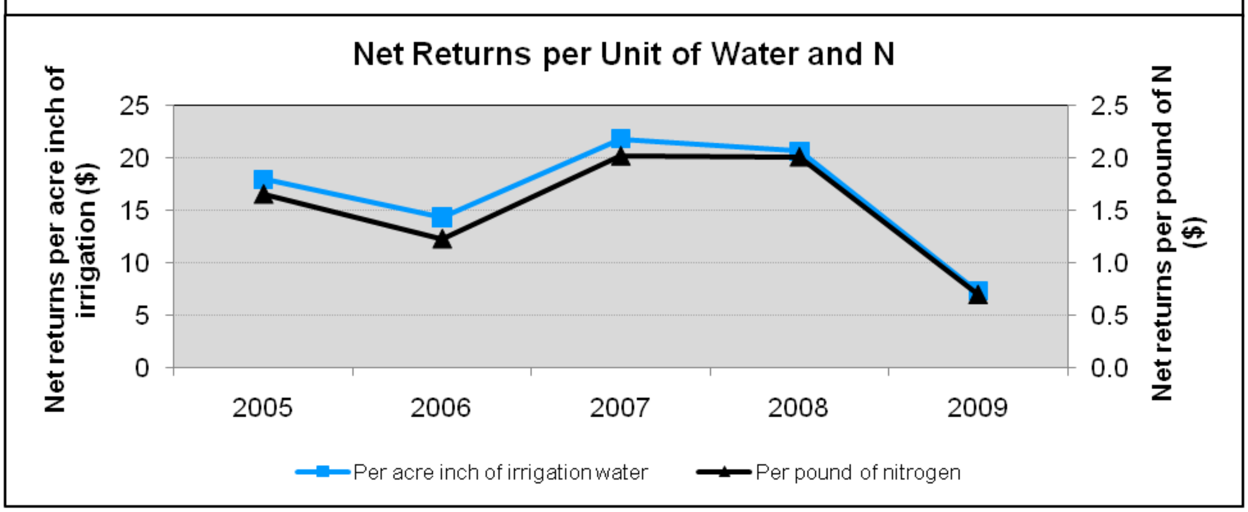

Site 17, Field 3 (July 2009)

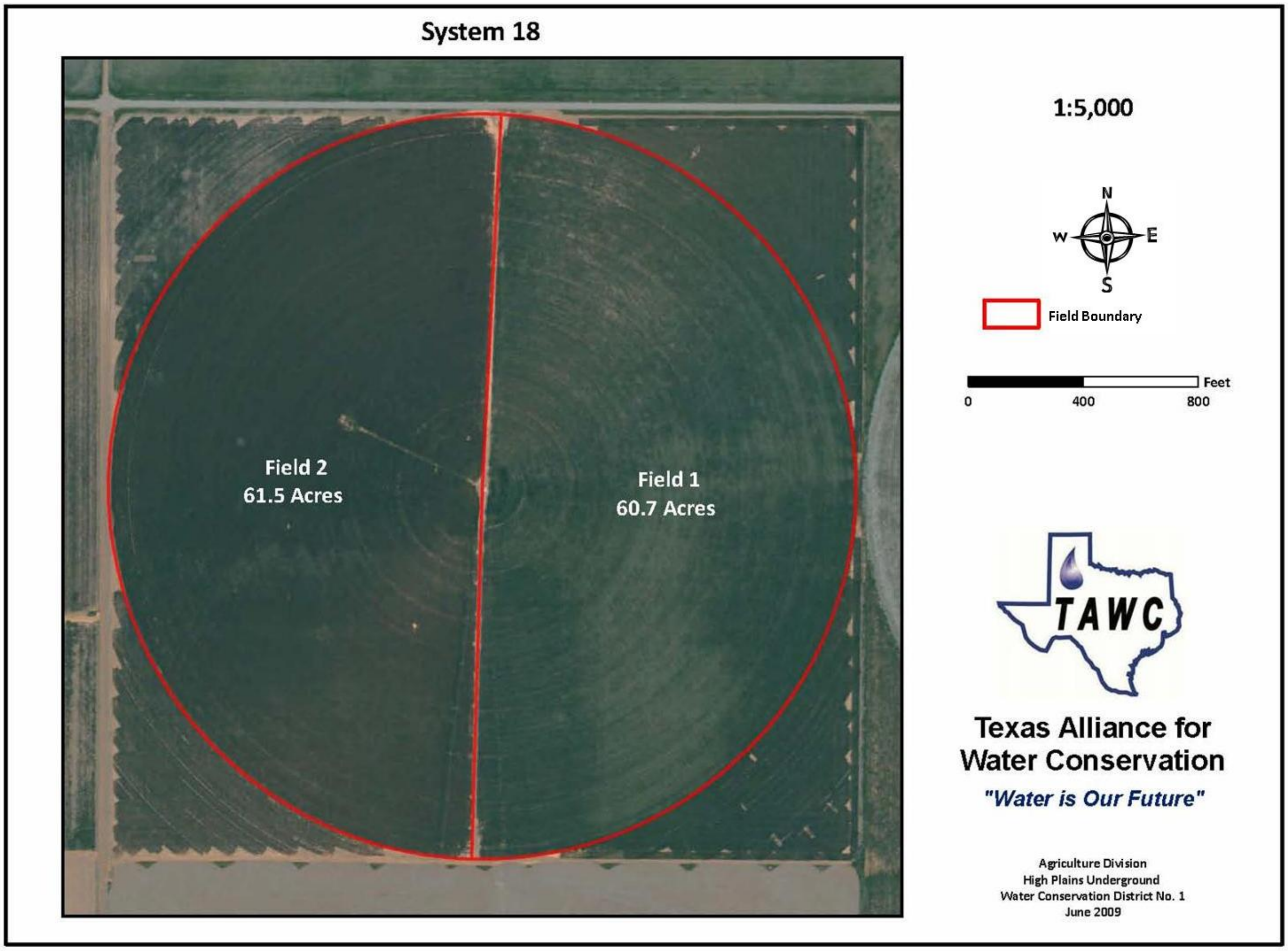

Site 17
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 17


Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
0
50
100
150
200
250
300
350
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
0
5
10
15
20
25
Net returns per pound of N ($)
0.0
0.5
1.0
1.5
2.0
2.5
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 18 Description

Total system acres: 122.2

Field No. 1 Acres: 60.7
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 61.5
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 250

Number of wells: 3

Fuel source: Electric

Comments: This is a pivot irrigated site with limited irrigation. Grain sorghum, cotton and wheat are planted on a rotational basis.

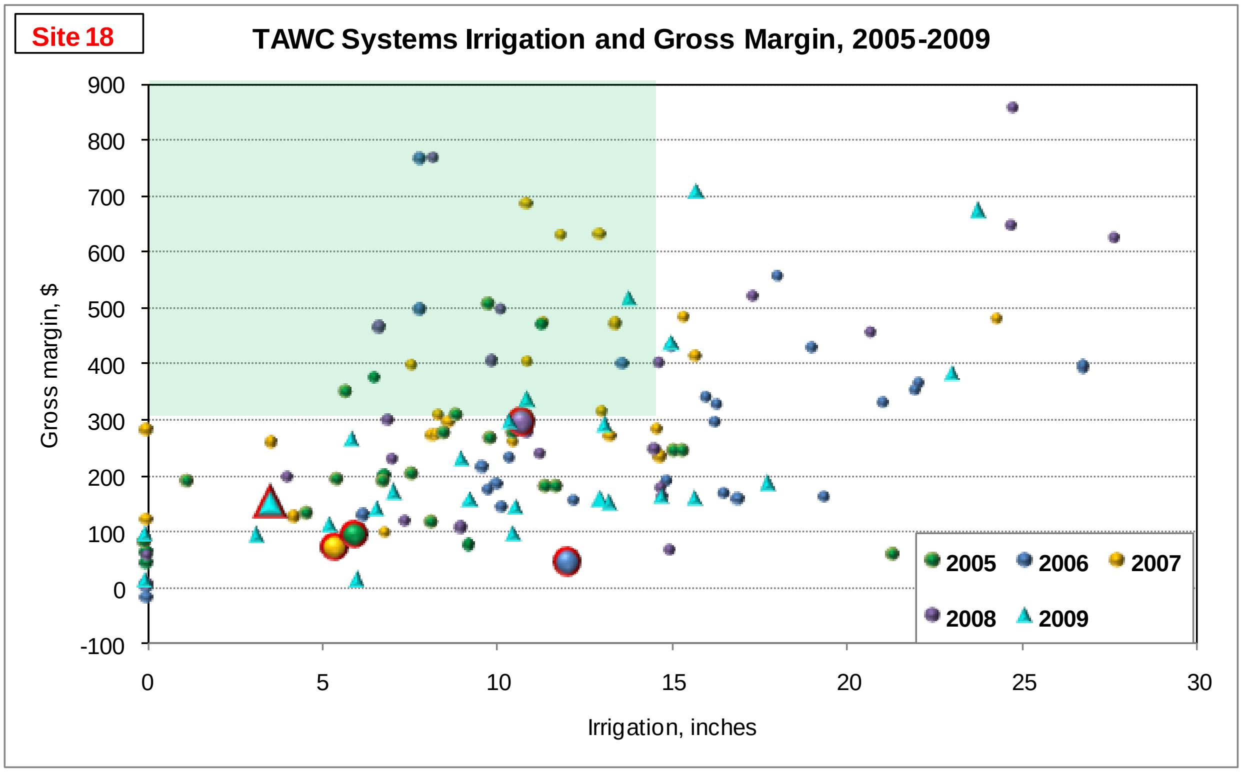
System 18

	Livestock	Field 1	Field 2
2005	None	Cotton	Grain Sorghum
2006	None	Cotton	Oats for silage followed by Forage Sorghum for hay
2007	None	Wheat for grain	Grain Sorghum
2008	None	Wheat for silage followed by Grain Sorghum	Cotton
2009	None	Cotton	Wheat

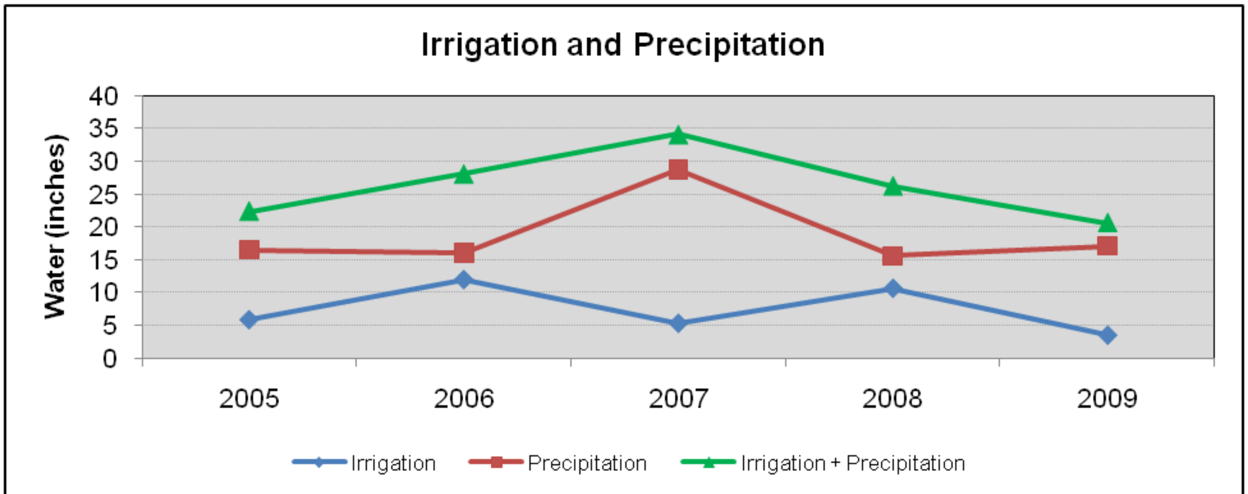
Site 18, Field 1 (July 2009)

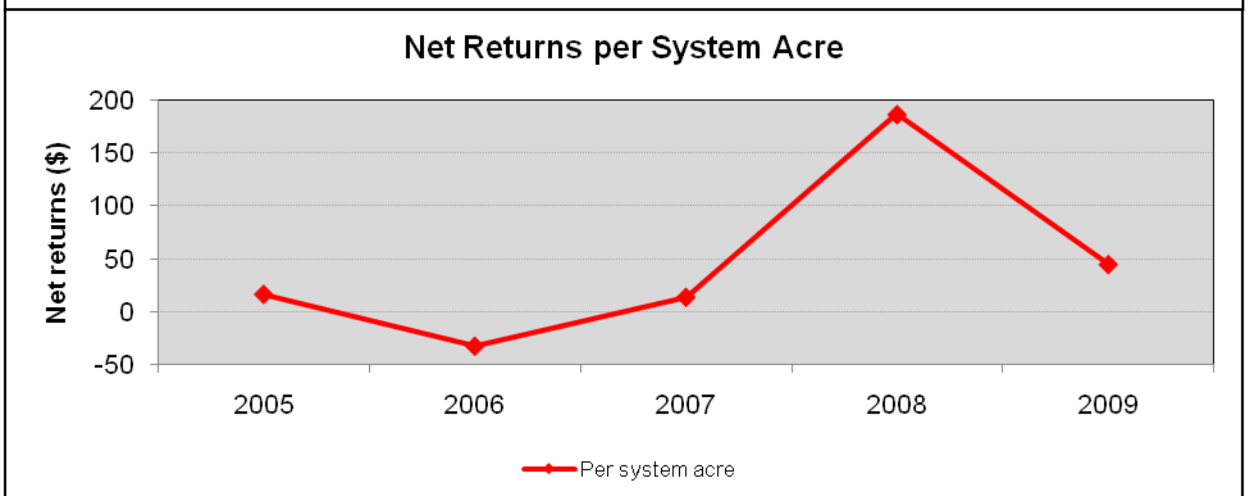
Site 18, Field 1 (November 2009)

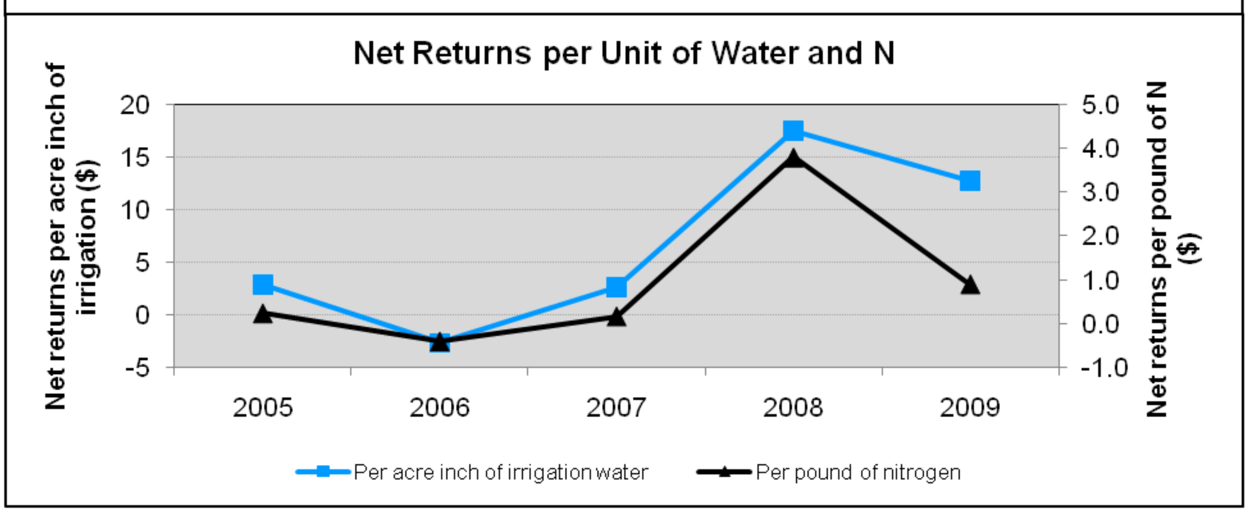
Site 18, Field 2 (May 2009)

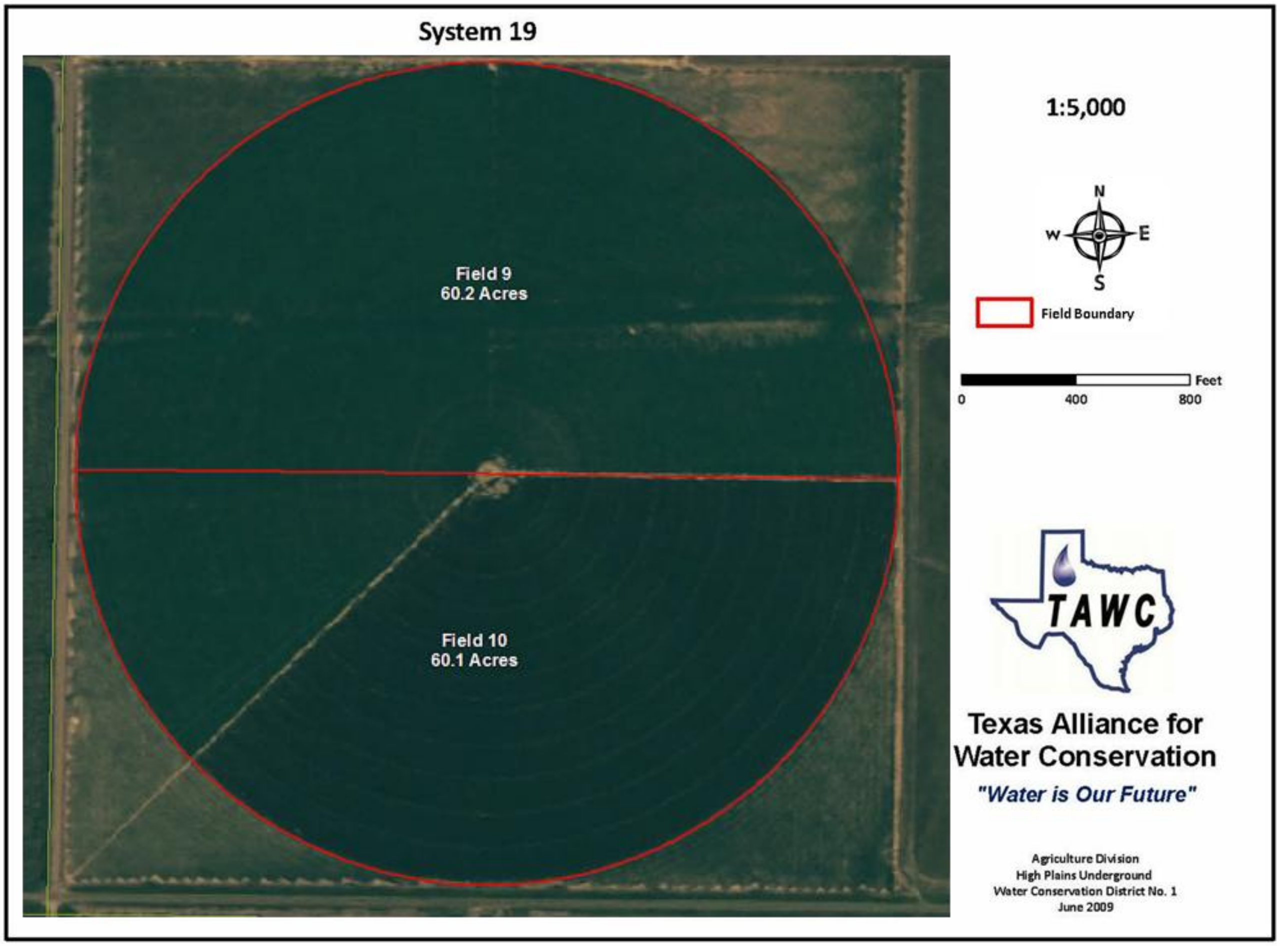

Site 18
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 18


Irrigation and Precipitation
Water (inches)
40
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
200
150
100
50
0
-50
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
20
15
10
5
0
-5
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 19 Description

Total system acres:	120.3
Field No. 9 Acres:	60.2
Major soil type:	Pullman clay loam; 0 to 1% slope
Field No. 10 Acres:	60.1
Major soil type:	Pullman clay loam; 0 to 1% slope

Irrigation

Type:	Center Pivot (LEPA)
Pumping capacity, gal/min:	400
Number of wells:	3
Fuel source:	Electric

Comments: This is a pivot irrigated cotton/wheat site using conventional tillage. Cotton is planted on forty-inch centers.

System 19

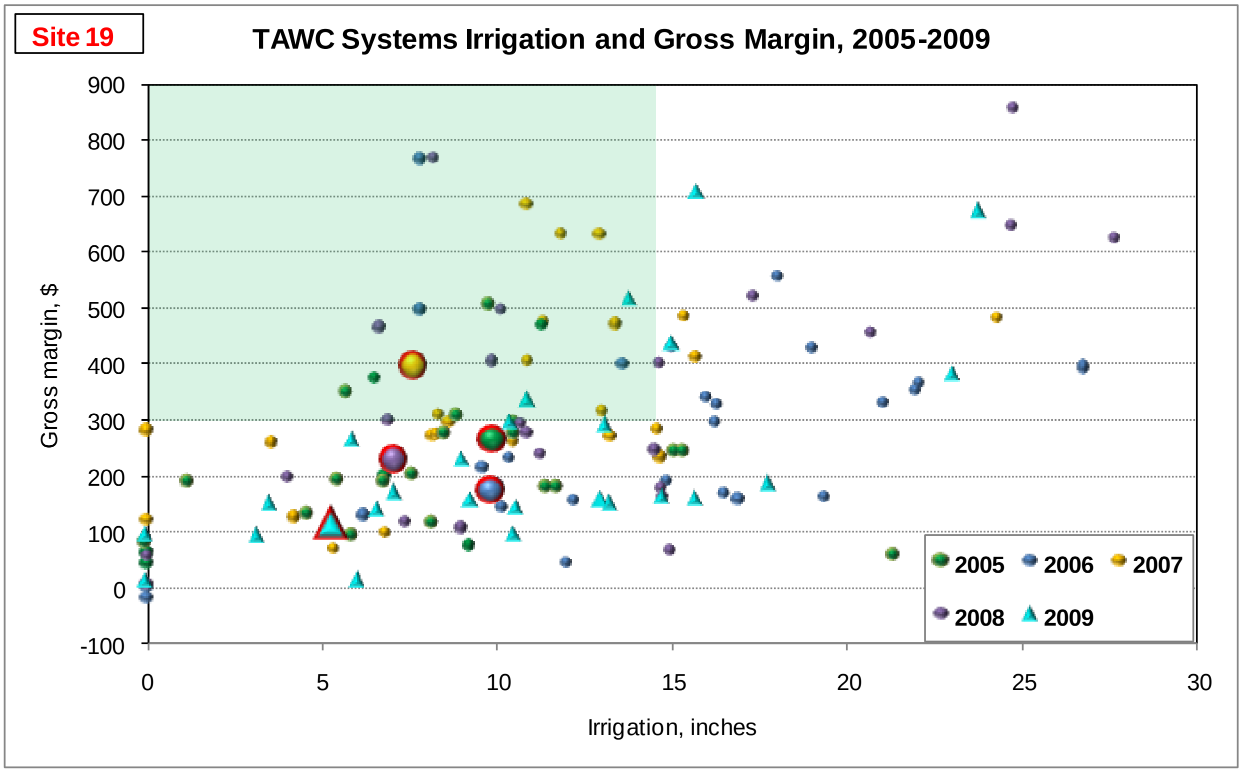
	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Field 7	Field 8	Field 9	Field 10
2005	None	Cotton	Pearlmillet for seed								
2006	None	Split into Fields 3 and 4		Pearlmillet for seed	Cotton						
2007	None			Split into Fields 5 and 6		Cotton	Pearlmillet for seed				
2008	None					Split into Fields 7 and 8		Cotton	Pearlmillet for seed		
2009	None							Split into Fields 9 and 10		Wheat	Cotton


Site 19, Field 9 (May 2009)


Site 19, Field 9 (July 2009)

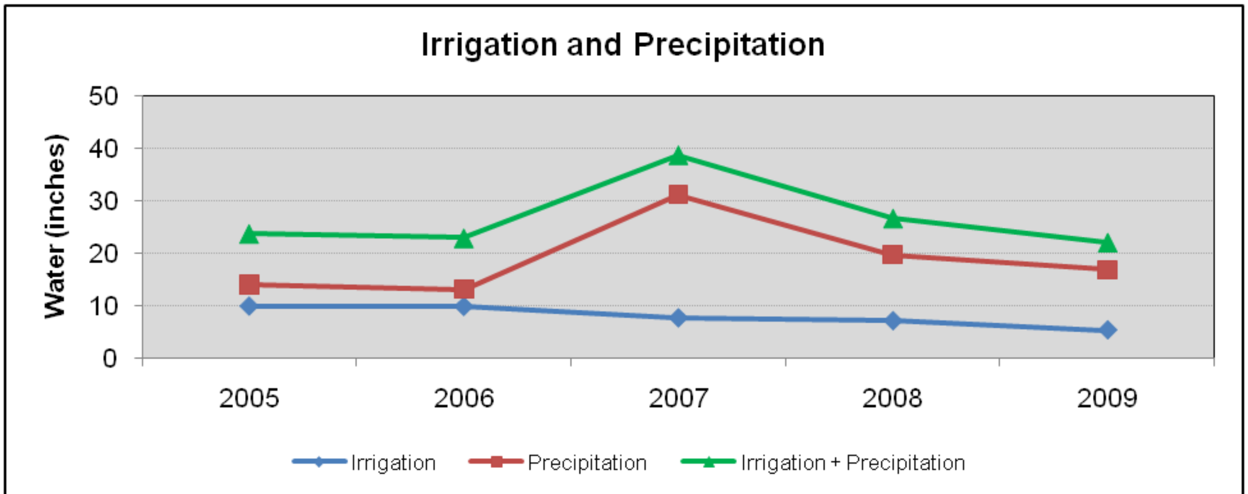

Site 19, Field 10 (May 2009)

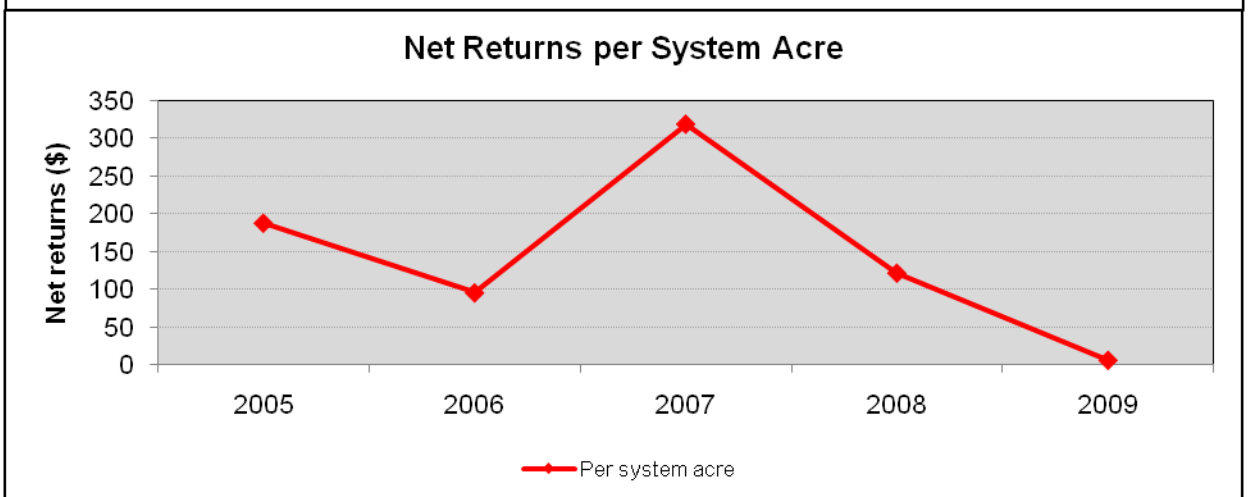

Site 19, Field 10 (July 2009)

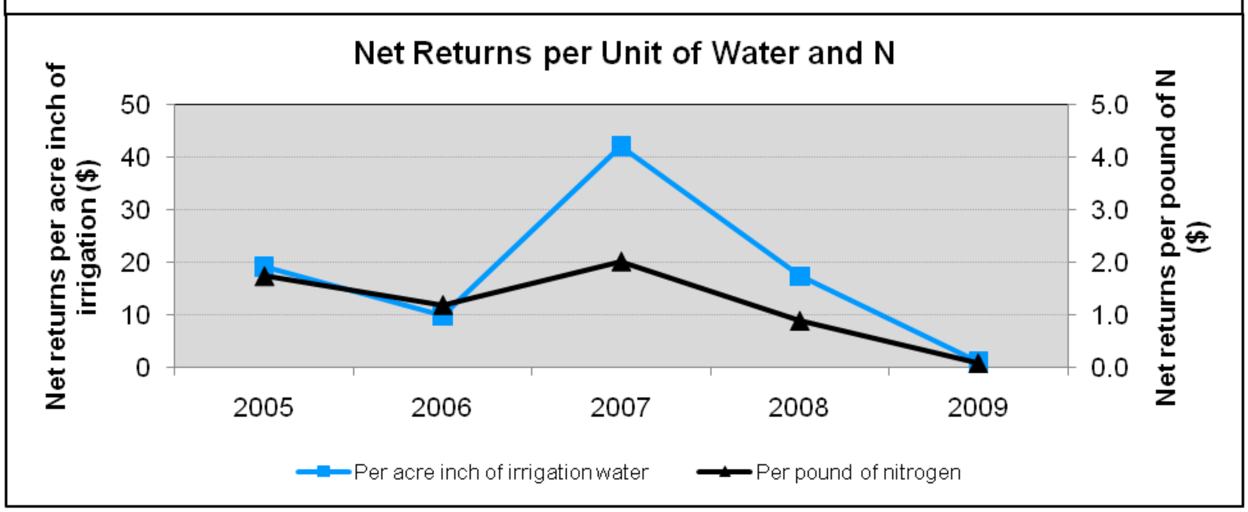


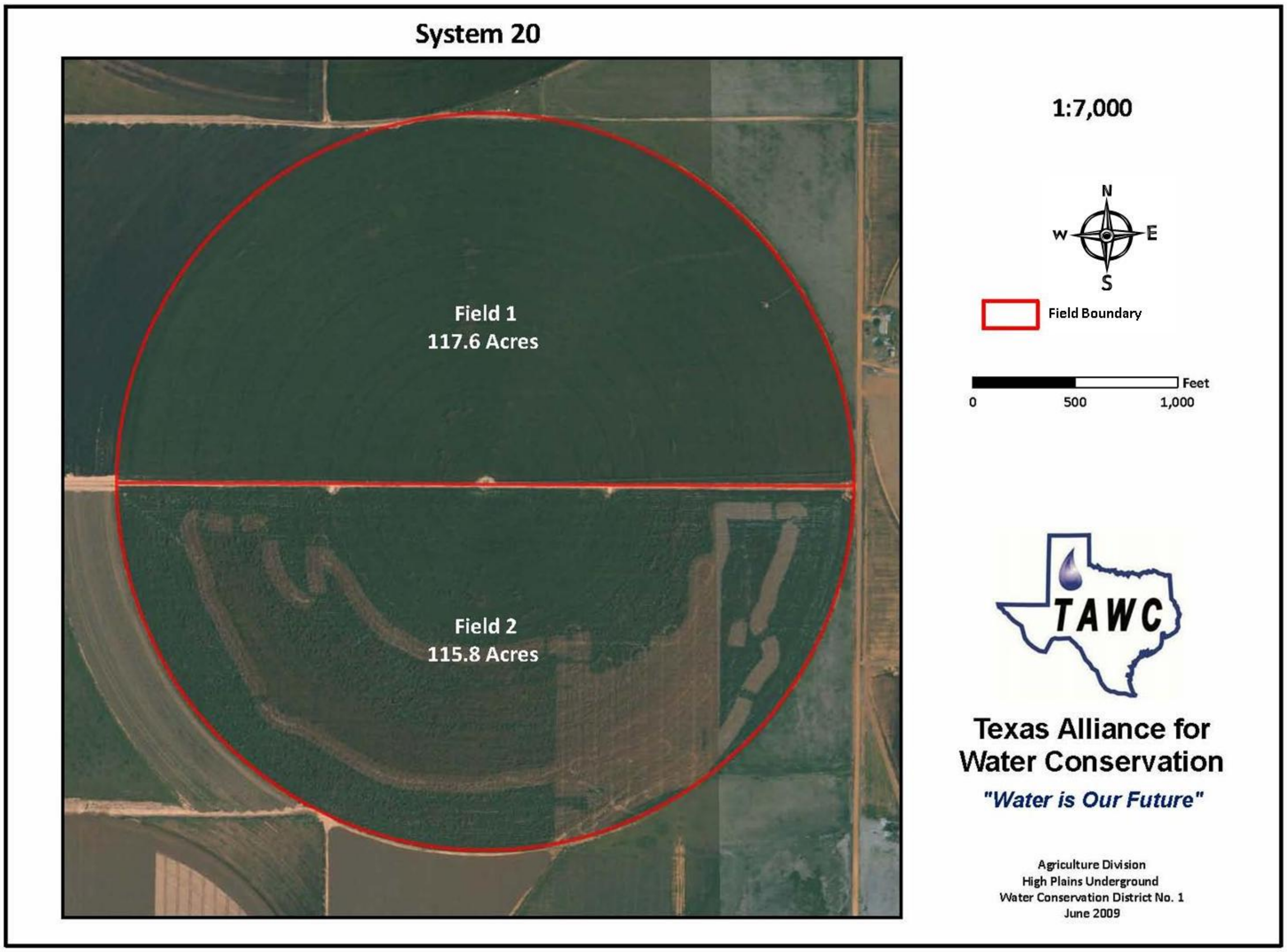
Site 19
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 19


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 20 Description

Total system acres: 233.4

Field No. 1 Acres: 117.6
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 115.8
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 1000

Number of wells: 3

Fuel source: Electric

Comments: This site was planted to corn for silage and cotton this year. Corn was planted on twenty-inch centers with cotton planted on forty-inch centers.

System 20

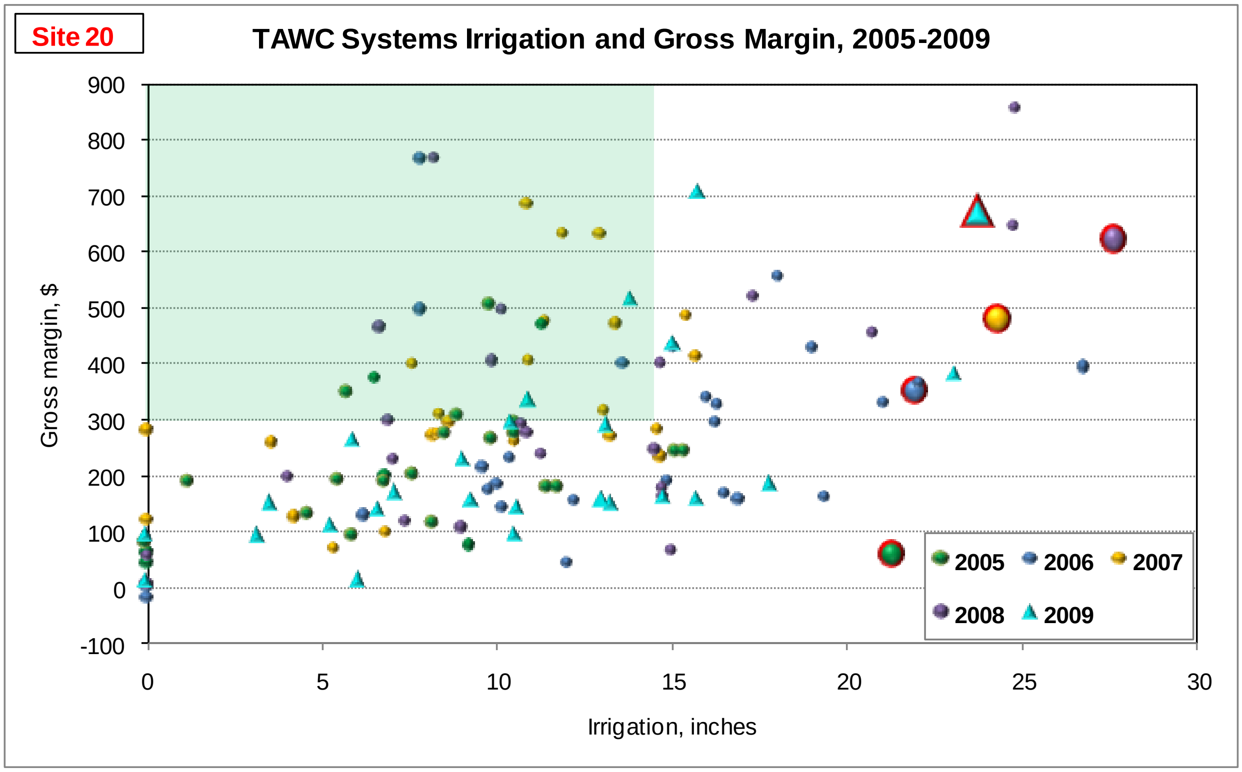
	Livestock	Field 1	Field 2
2005	None	Wheat for silage followed by Forage Sorghum for silage	Corn for silage
2006	None	Corn for silage	Triticale for silage followed by Forage Sorghum for silage
2007	None	Triticale for silage, followed by Corn for silage	Triticale for silage, followed by Forage Sorghum for silage
2008	None	Wheat for grain followed by Grain Sorghum for grain and residue for hay	Wheat for grain followed by Grain Sorghum for silage
2009	None	Cotton	Corn for silage

Site 20, Field 1 (July 2009)

Site 20, Field 1 (October 2009)

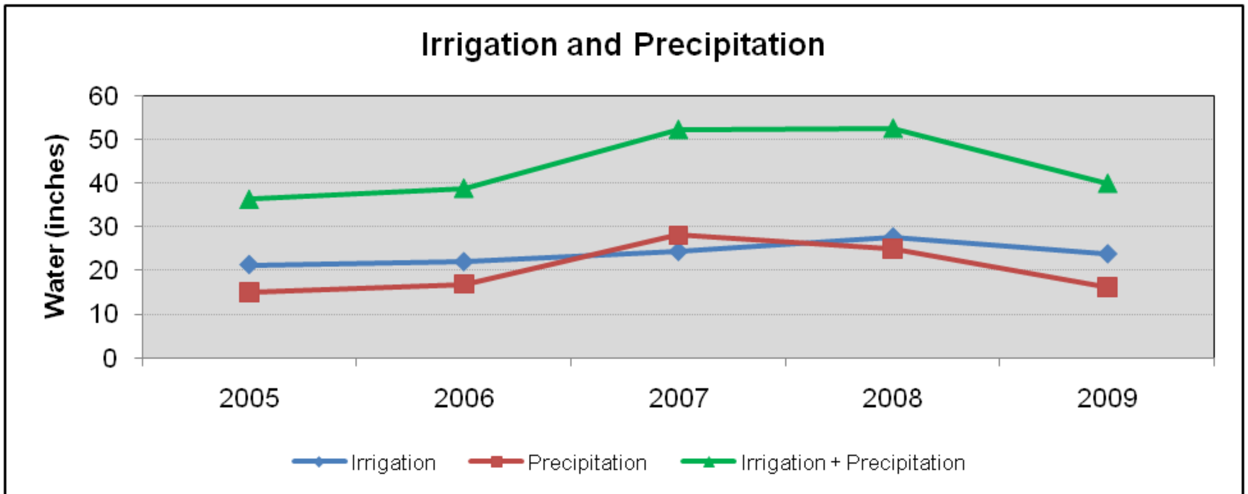
Site 20, Field 2 (May 2009)

Site 20, Field 2 (August 2009)

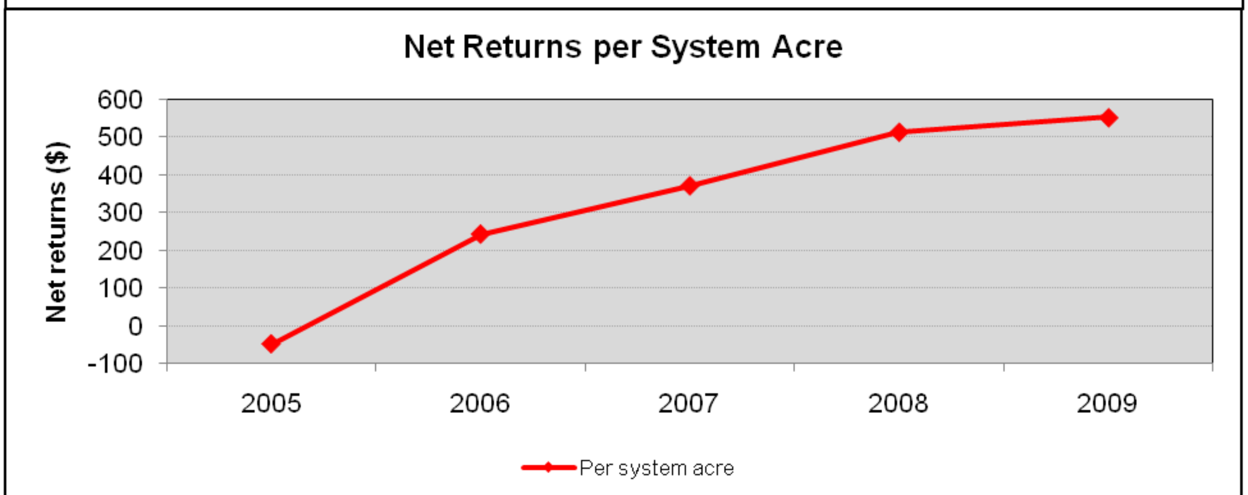


Site 20
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

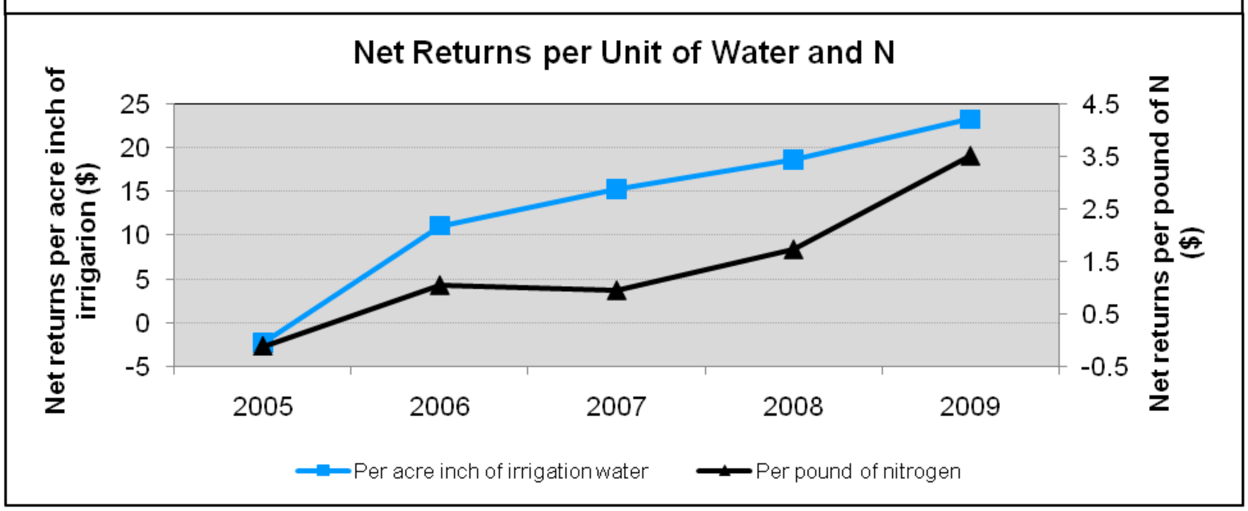
System 20



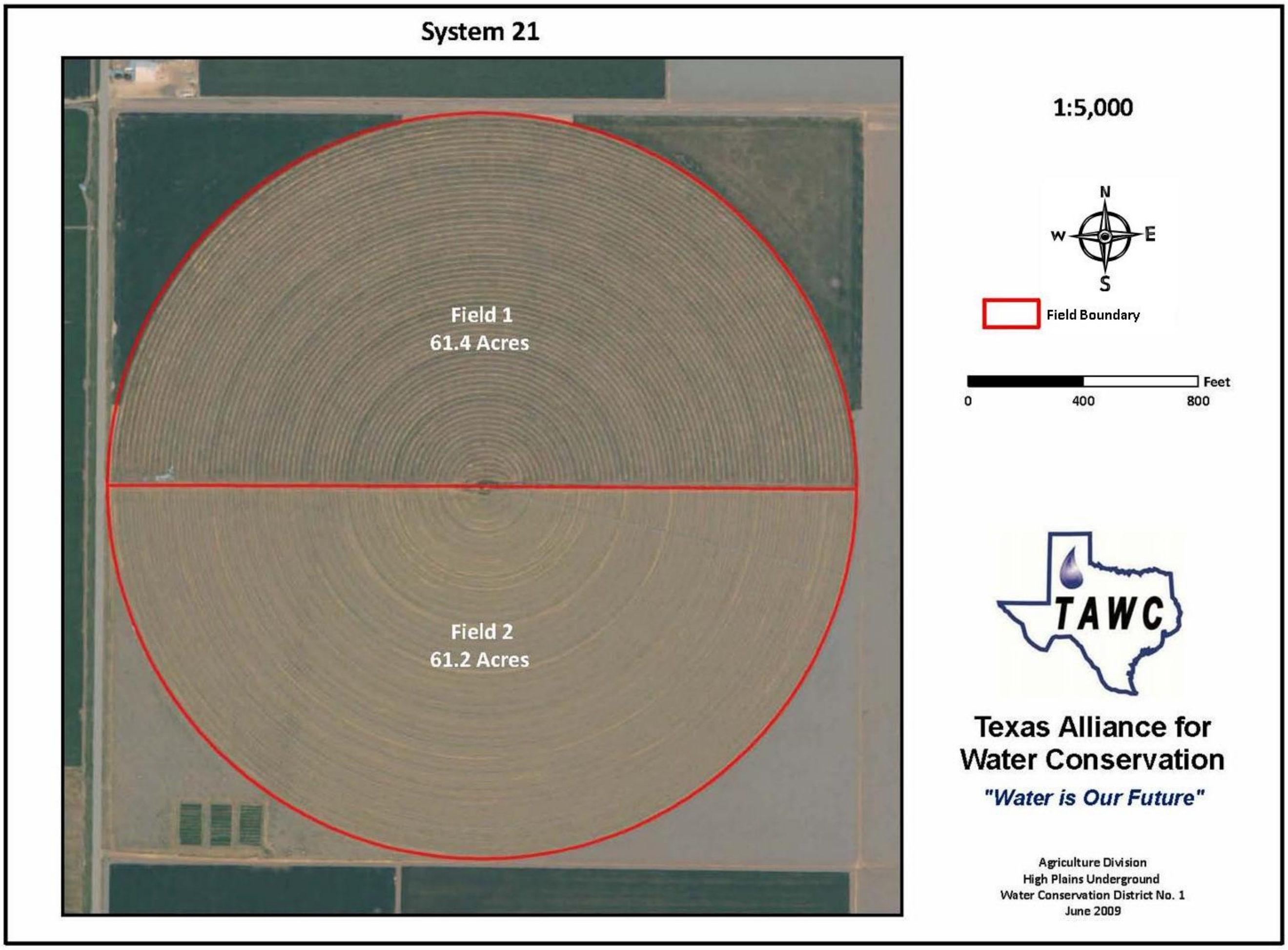
Irrigation and Precipitation
Water (inches)
60
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
600
500
400
300
200
100
0
-100
2005
2006
2007
2008
2009
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigarion ($)
25
20
15
10
5
0
-5
2005
2006
2007
2008
2009
4.5
3.5
2.5
1.5
0.5
-0.5
Net returns per pound of N ($)
Per acre inch of irrigation water
Per pound of nitrogen



System 21 Description

Total system acres: 122.6

Field No. 1 Acres: 61.4
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 61.2
Major soil type: Pullman clay loam

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 500

Number of wells: 1

Fuel source: Electric

Comments: This is a pivot irrigated site with one-half planted to side-oats grama harvested for seed with the grass residue baled for hay and sold. Wheat was planted on the balance of this site for seed production and then double cropped to forage sorghum for hay production.

System 21

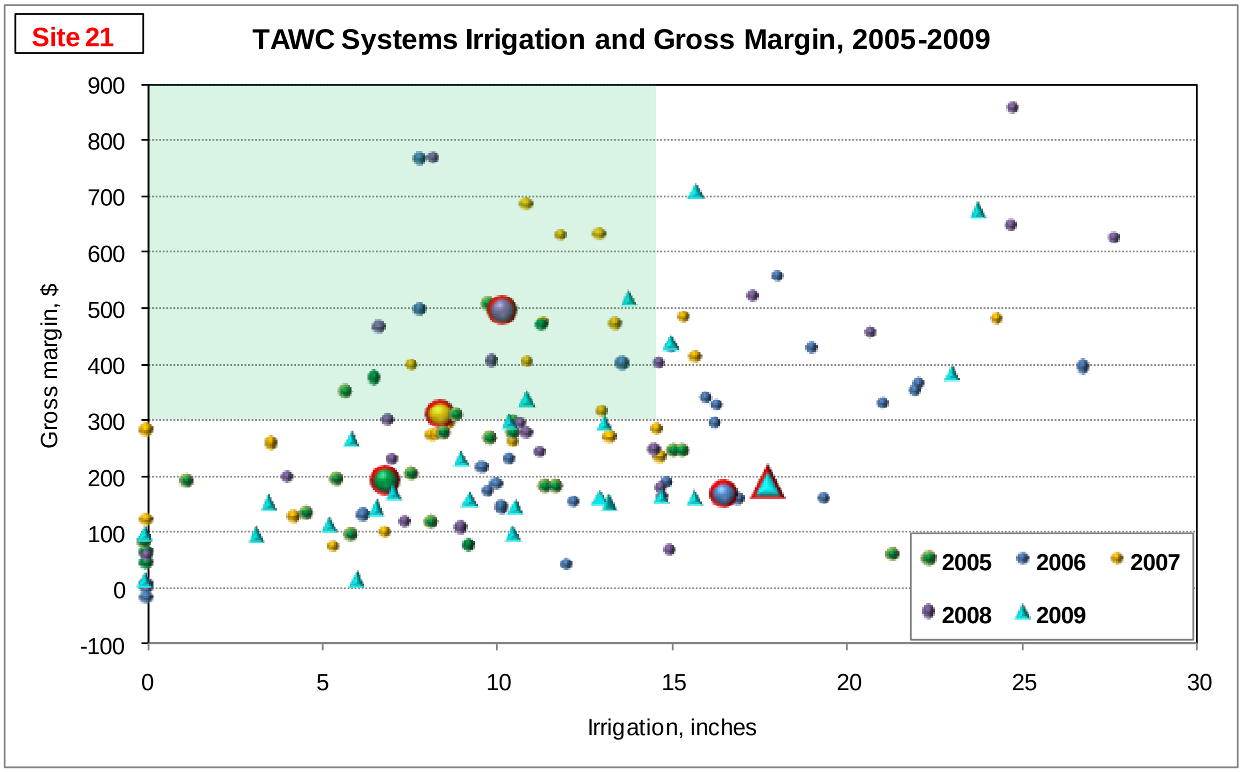
	Livestock	Field 1	Field 2
2005	None	Cotton	Cotton
2006	Stocker steers	Corn for grain	Wheat for grazing and cover followed by Cotton
2007	None	Sideoats grama grass for seed and hay	Corn for grain
2008	None	Sideoats grama grass for seed and hay	Barley for seed followed by Forage Sorghum for hay
2009	None	Sideoats grama grass for seed and hay	Wheat/Forage sorghum for hay

Site 21, Field 1 (May 2009)

Site 21, Field 1 (September 2009)

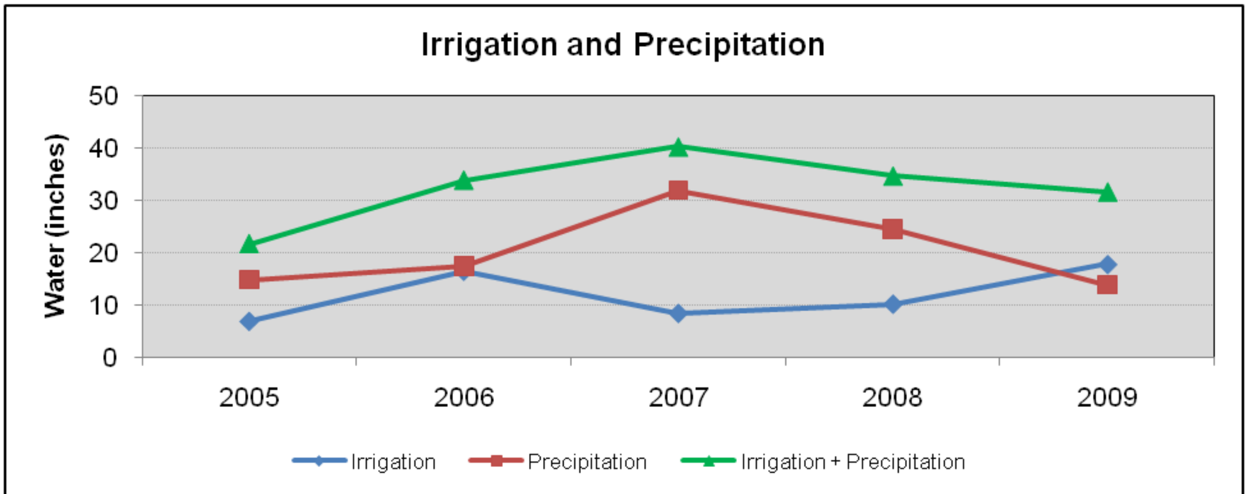
Site 21, Field 2 (May 2009)

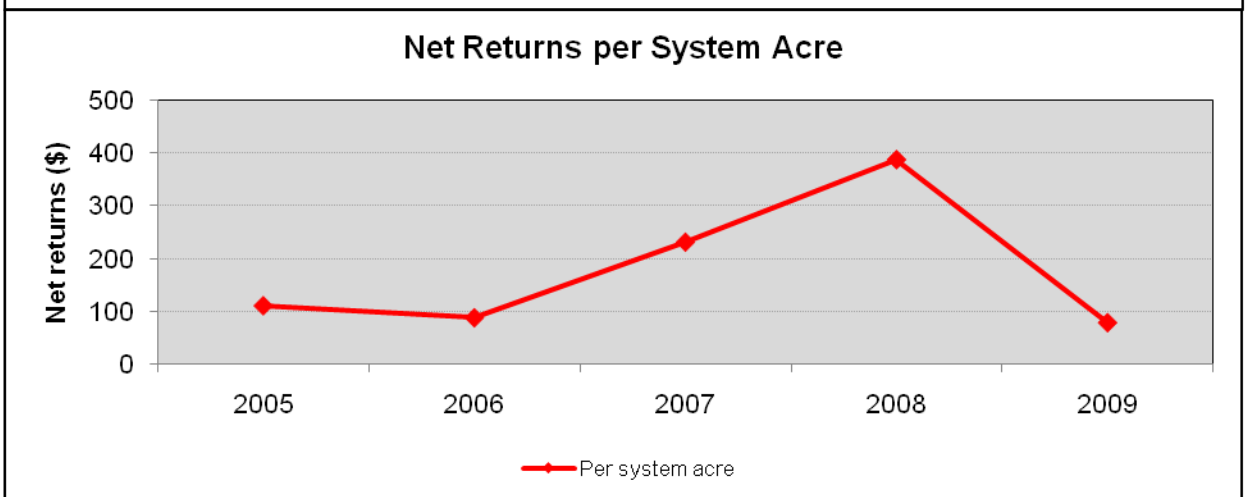
Site 21, Field 2 (June 2009)

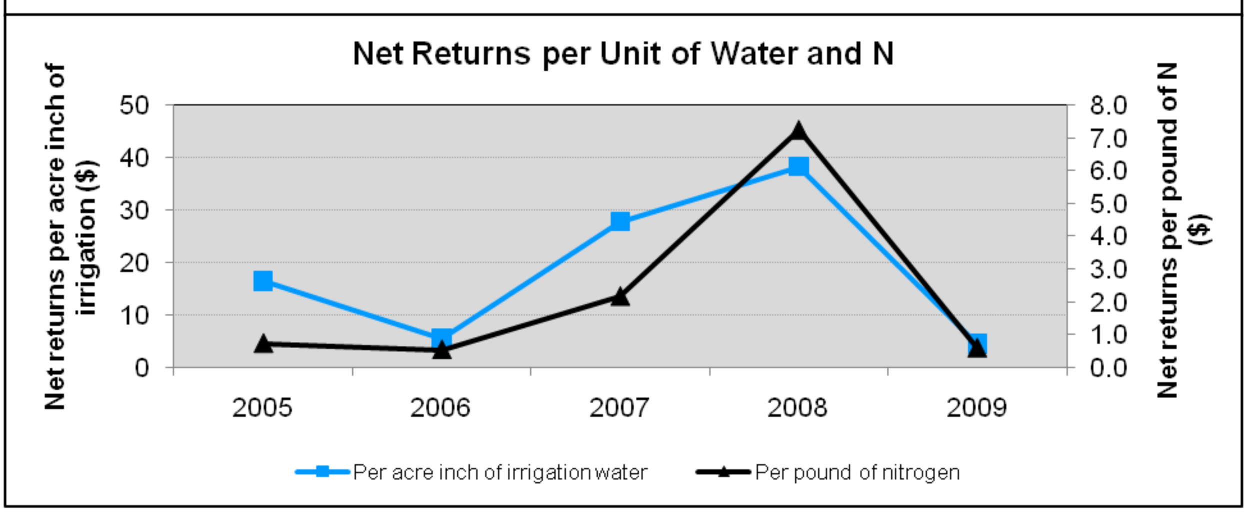


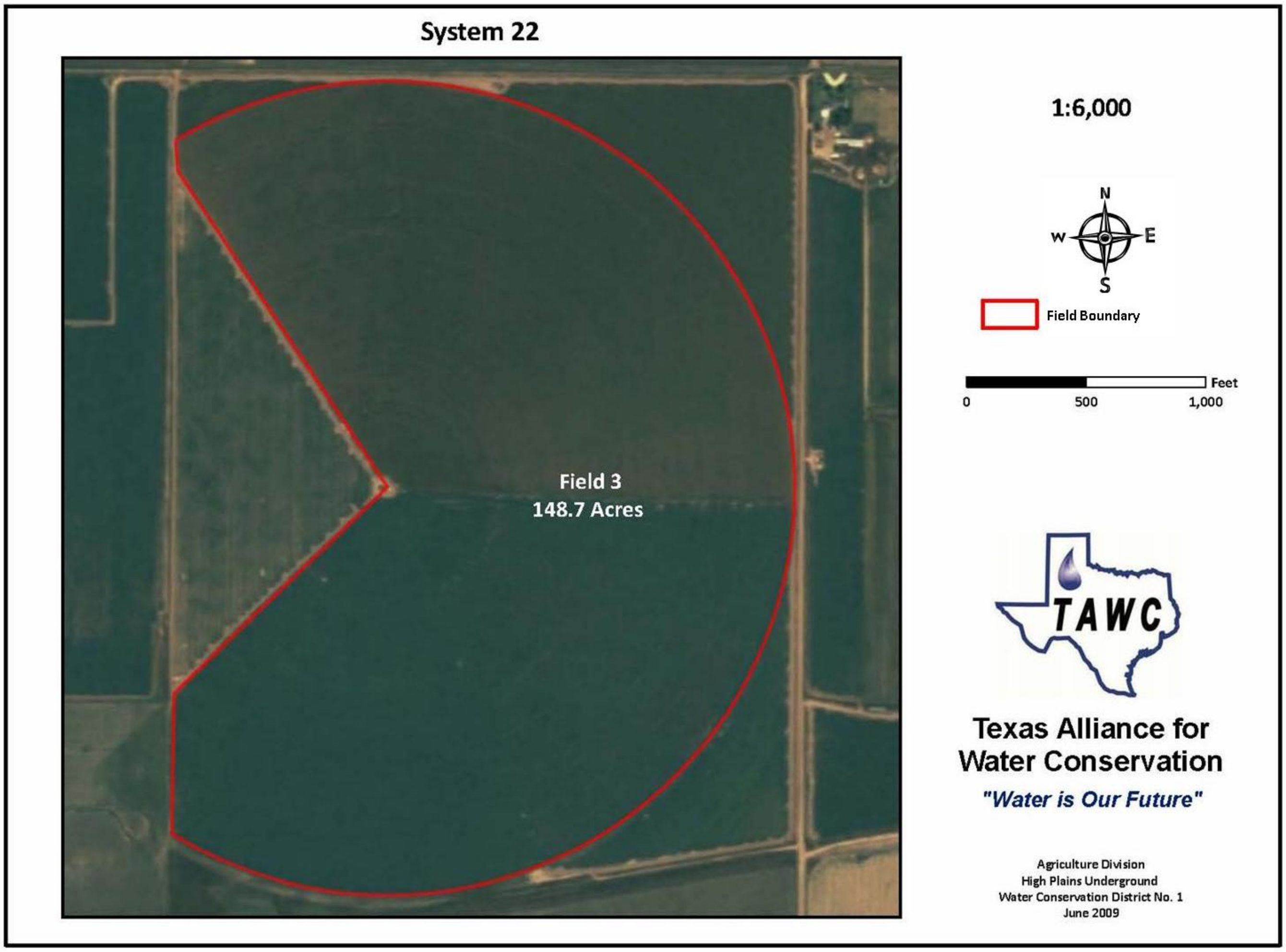
Site 21
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 21


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
500
400
300
200
100
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 22 Description

Total system acres: 148.7

Field No. 3 Acres: 148.7
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LEPA)

Pumping capacity, gal/min: 800

Number of wells: 4

Fuel source: Electric

Comments: This is a pivot irrigated corn/cotton system. In 2009 both fields were planted to cotton on thirty-inch centers.

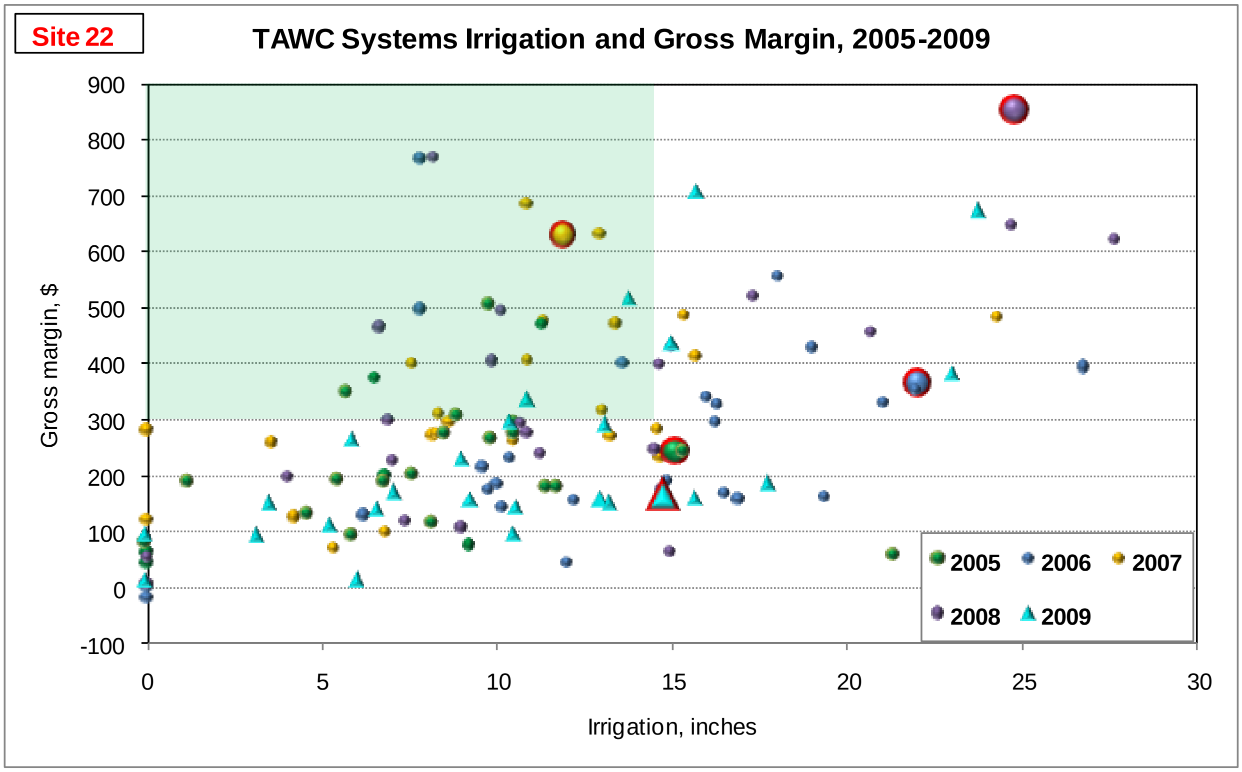
System 22

	Livestock	Field 1	Field 2	Field 3
2005	None	Corn for grain	Cotton	
2006	None	Cotton	Corn for grain	
2007	None	Cotton following Wheat cover crop	Cotton	
2008	None	Corn for grain	Corn for grain	
2009	None	Combined into Field 3		Cotton

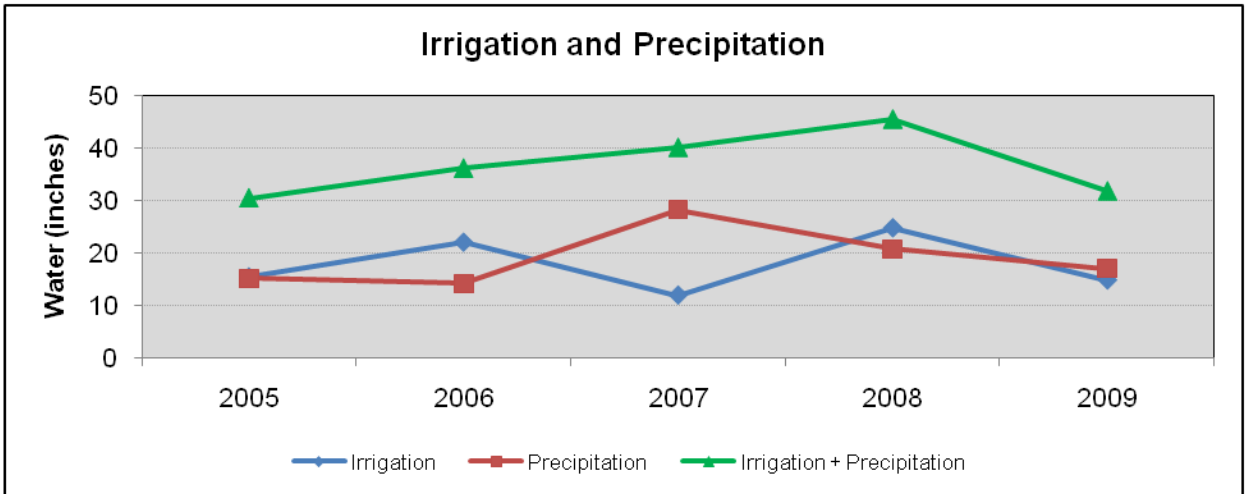
Site 22, Field 3 (May 2009)

Site 22, Field 3 (July 2009)

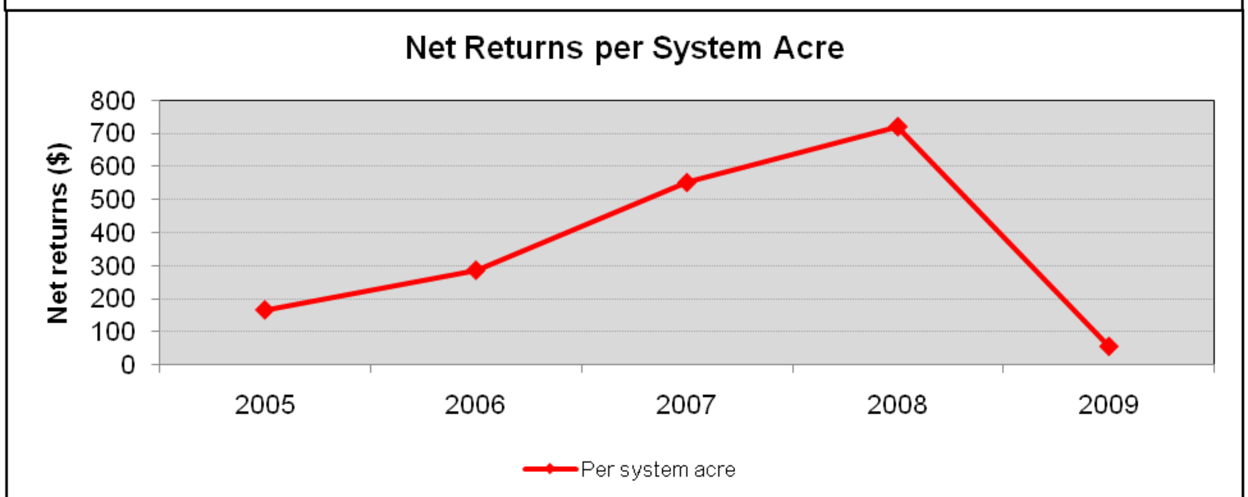
Site 22, Field 3 (October 2009)


Site 22
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
Irrigation, inches
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
2005
2006
2007
2008
2009

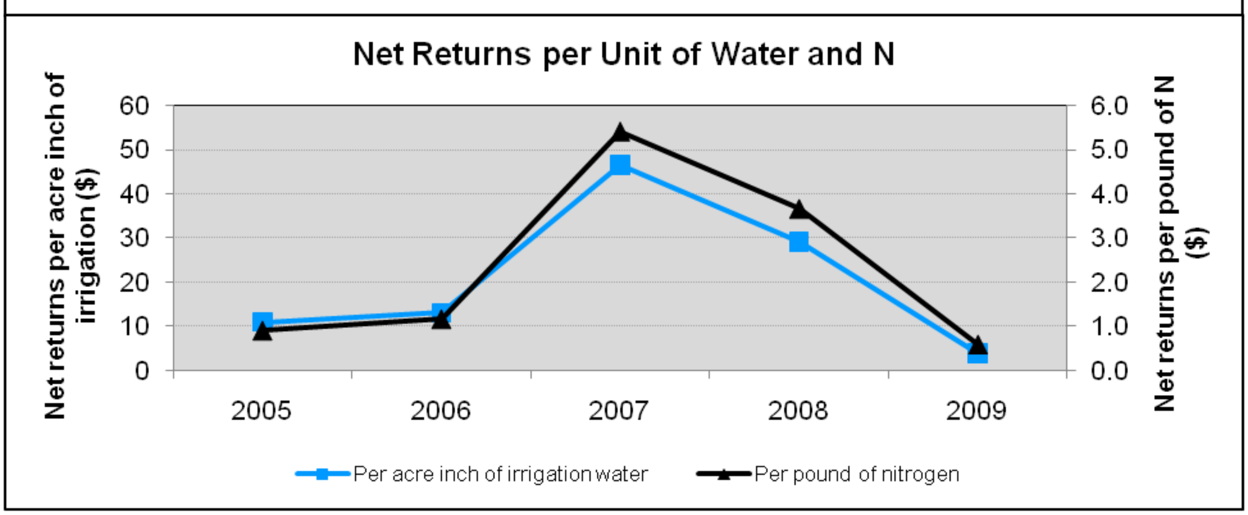
System 22



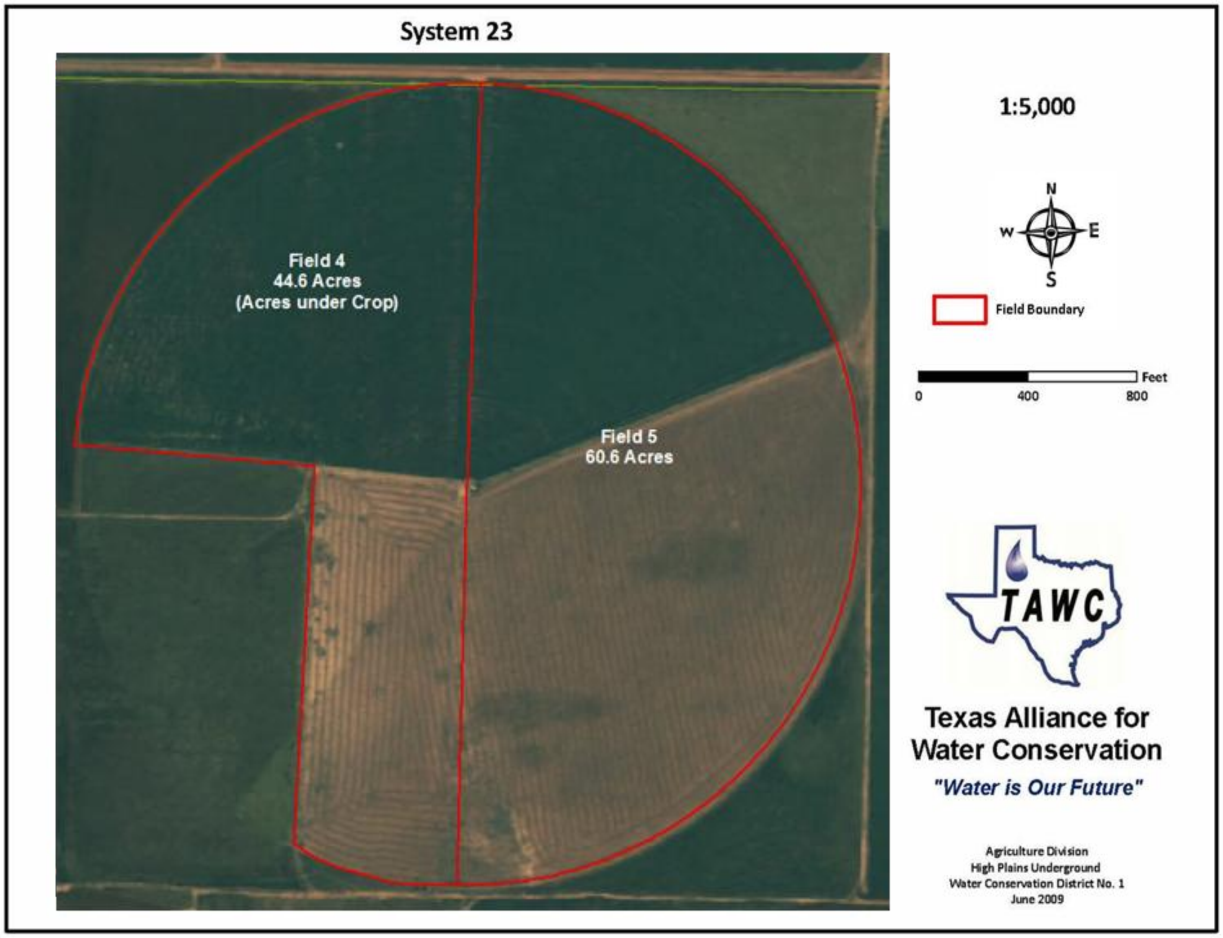
Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
800
700
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
60
50
40
30
20
10
0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 23 Description

Total system acres: 105.2

Field No. 4 Acres: 44.6
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 5 Acres: 60.6
Major soil type: Pullman clay loam, 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 800

Number of wells: 2

Fuel source: Natural gas

Comments: This pivot was planted to oats and wheat for silage in 2009. It was then double cropped to forage sorghum for silage.

System 23

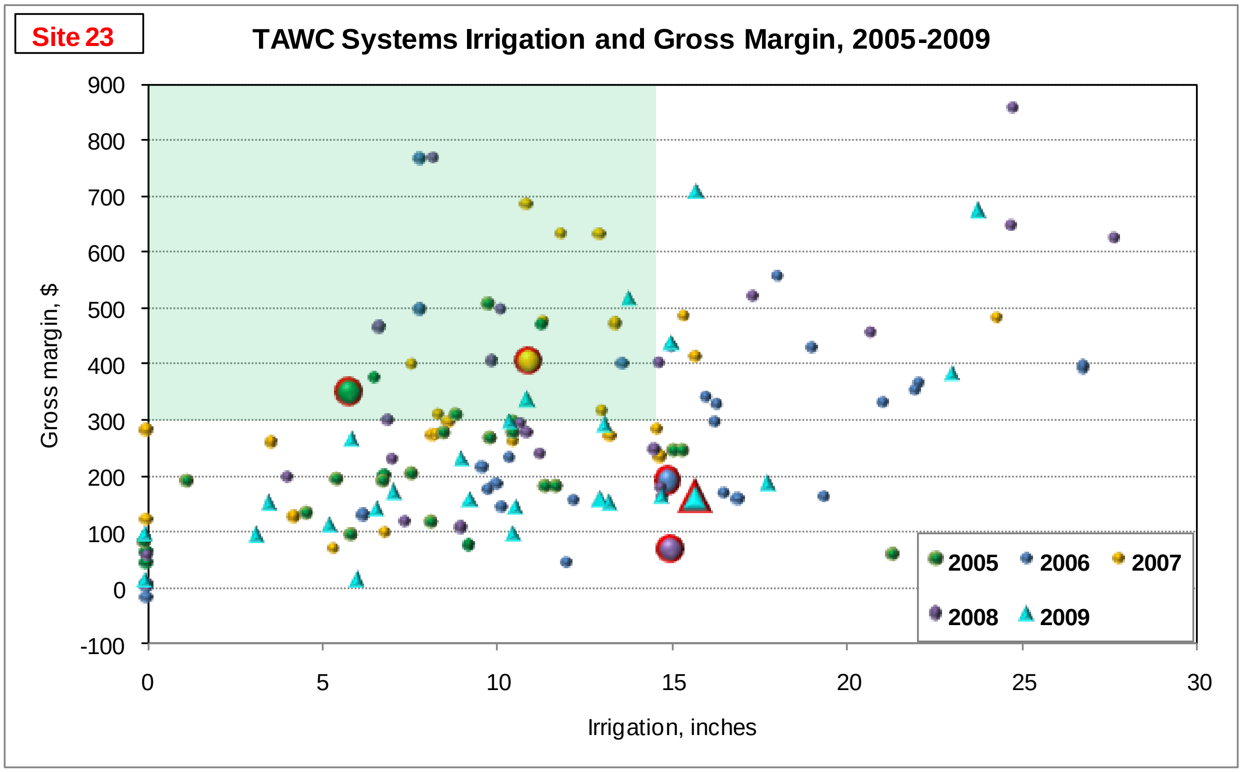
	Livestock	Field 1	Field 2	Field 3	Field 4	Field 5
2005	None	Cotton	Sunflowers for seed	Cotton (dryland)		
2006	None	Cotton	Corn for grain	Cotton		
2007	None	Corn for grain	Corn for grain	Corn for grain		
2008	None	Split into Fields 4 and 5		Sunflowers	Sunflowers	Cotton
2009				Combined with Field 4	Oats/Forage sorghum for silage	Wheat/Forage sorghum for silage

Site 23, Field 4 (January 2009)

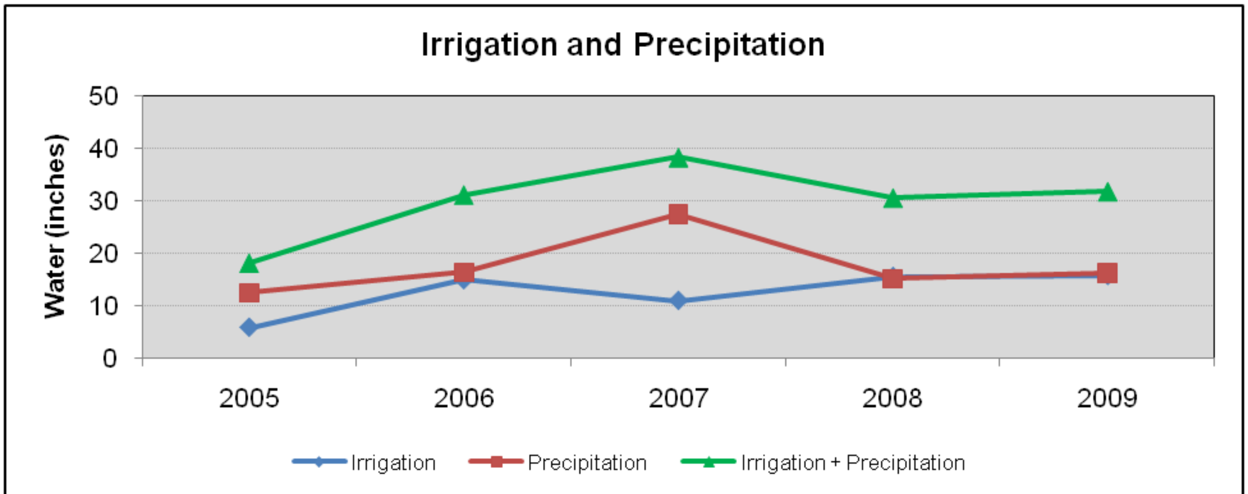
Site 23, Field 4 (September 2009)

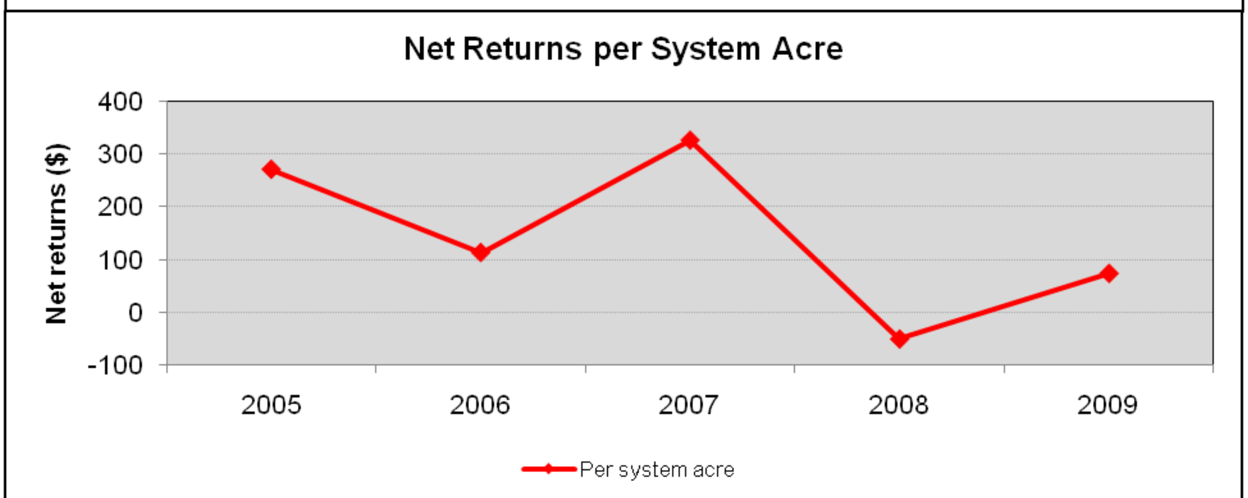
Site 23, Field 5 (April 2009)

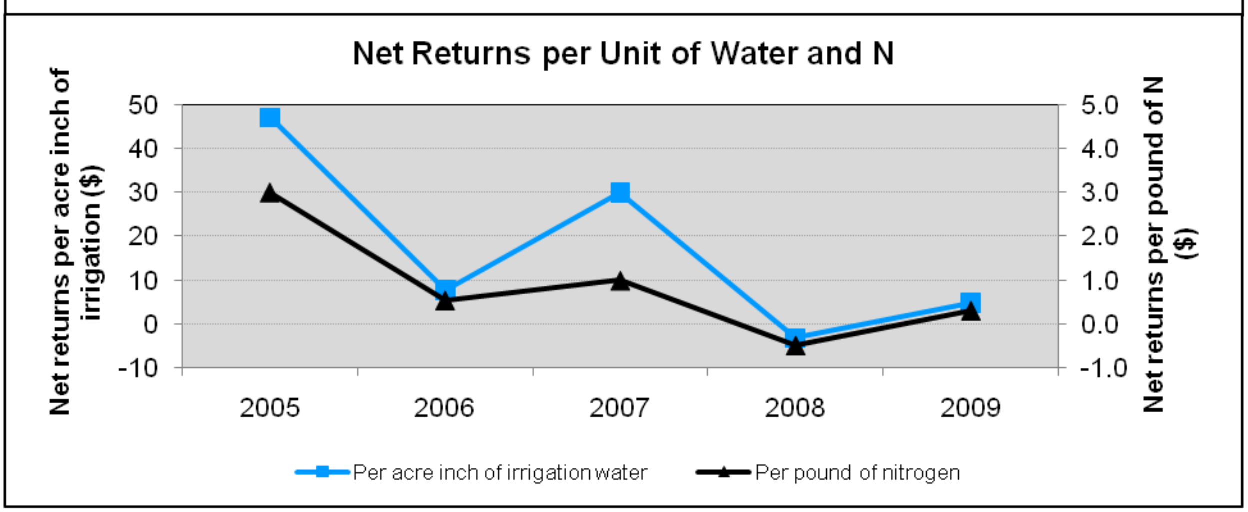
Site 23, Field 5 (June 2009)

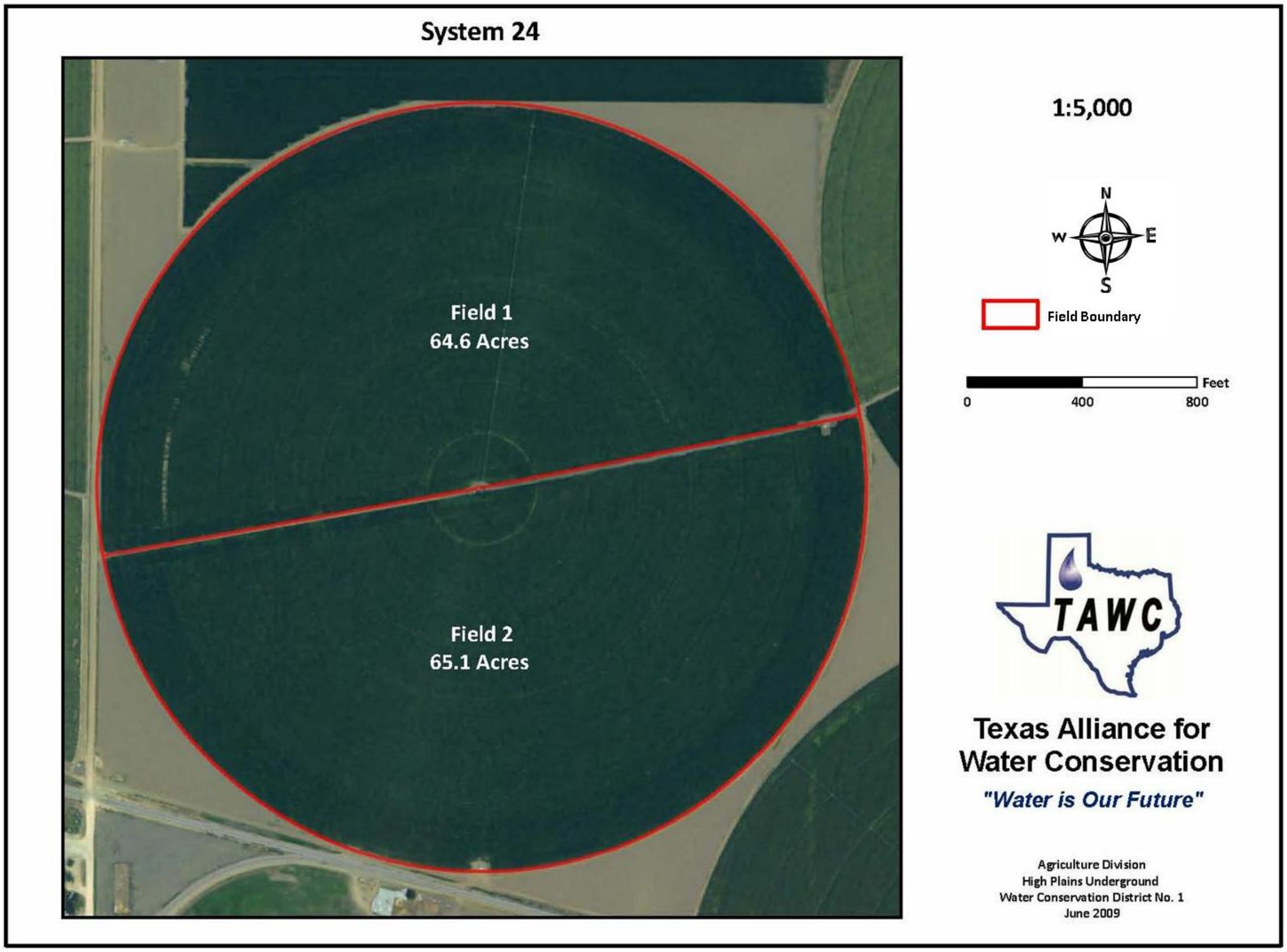

Site 23
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 23


Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
400
300
200
100
0
-100
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
50
40
30
20
10
0
-10
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 24 Description

Total system acres: 129.7

Field No. 1 Acres: 64.6
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 65.1
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 700

Number of wells: 1

Fuel source: Diesel

Comments: This has been a corn/cotton/sunflower pivot irrigated system using conventional tillage. In 2009 it was planted to sunflowers/white food corn.

System 24

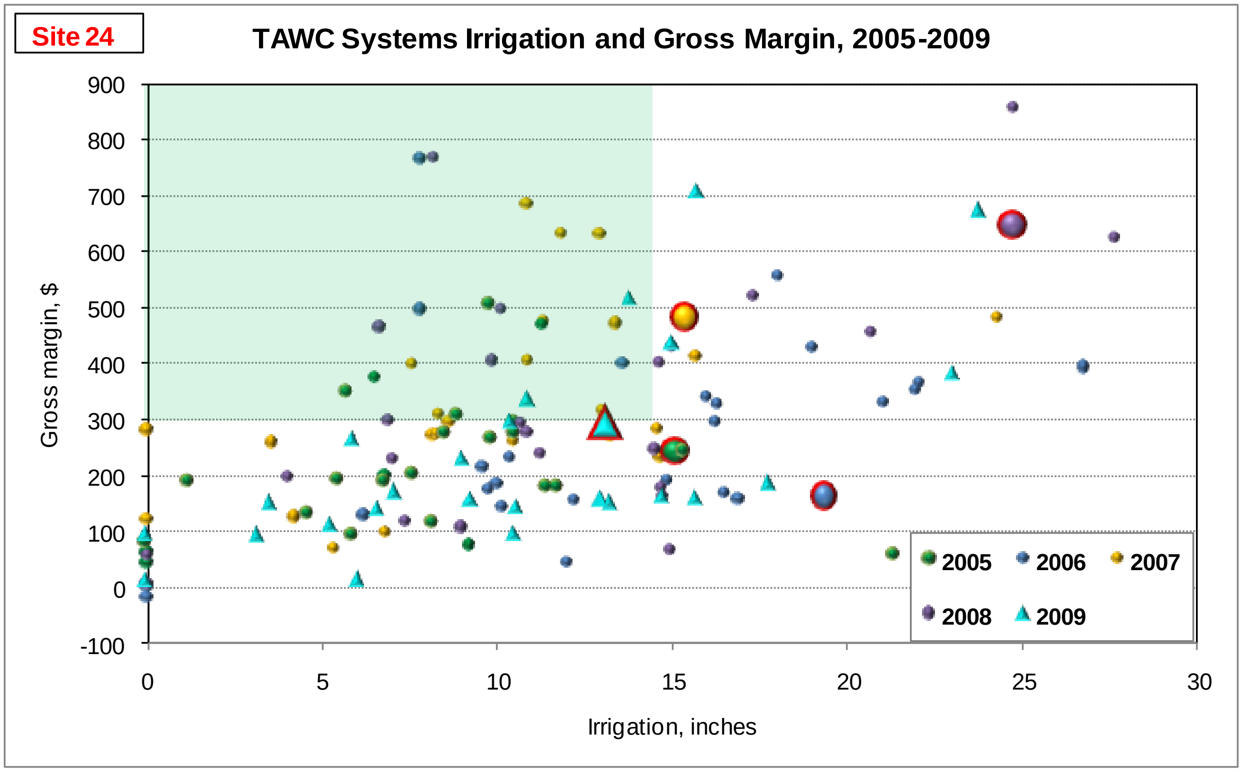
	Livestock	Field 1	Field 2
2005	None	Cotton	Corn for grain
2006	None	Corn for grain	Cotton
2007	None	Corn for grain	Corn for grain
2008	None	Corn for grain	Corn for grain
2009	None	Corn	Sunflowers


Site 24, Field 1 (June 2009)

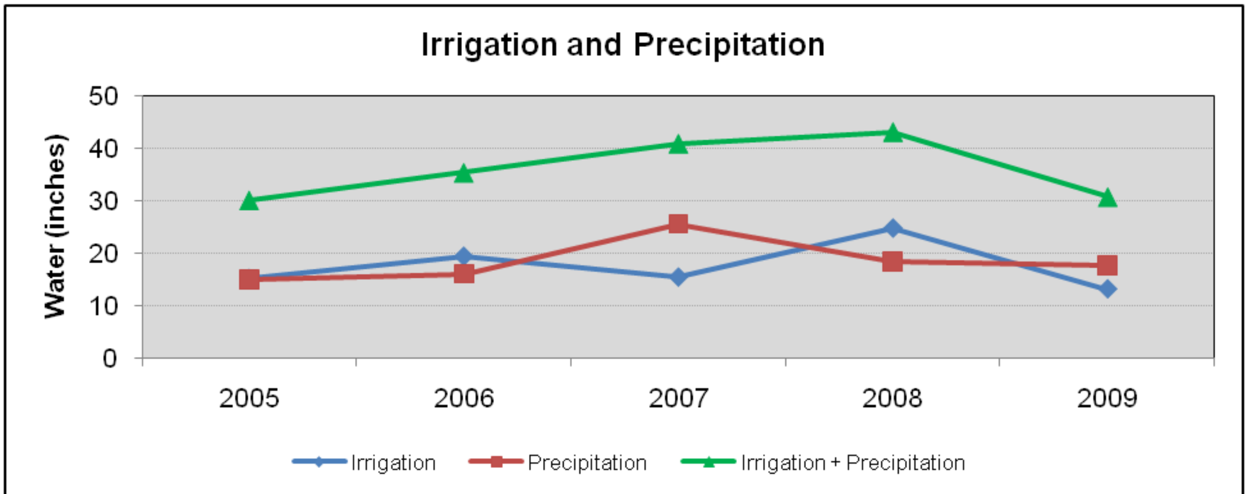

Site 24, Field 1 (September 2009)


Site 24, Field 2 (July 2009)

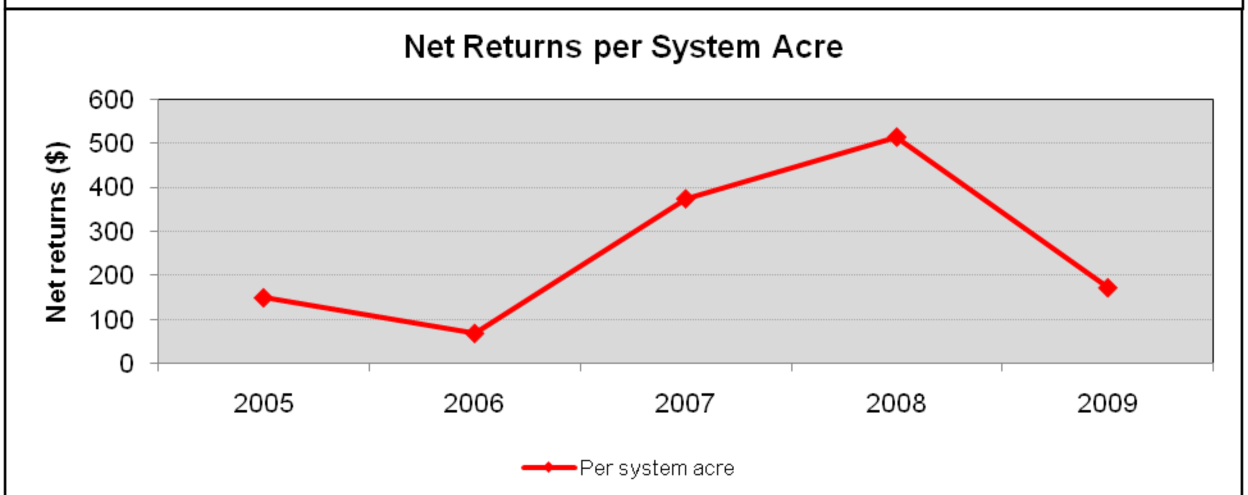

Site 24, Field 2 (September 2009)


Site 24
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

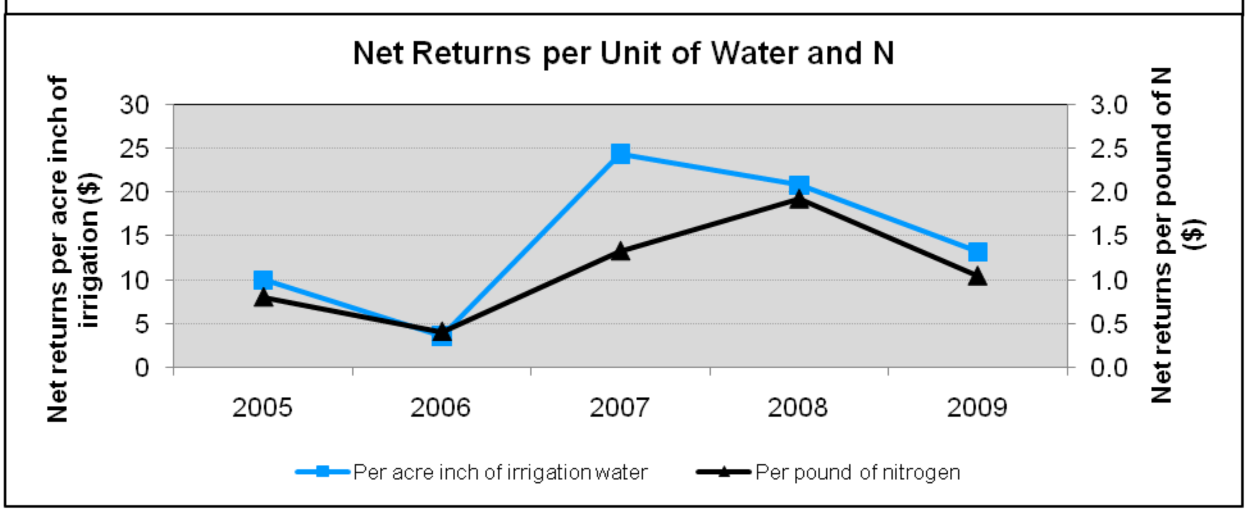
System 24



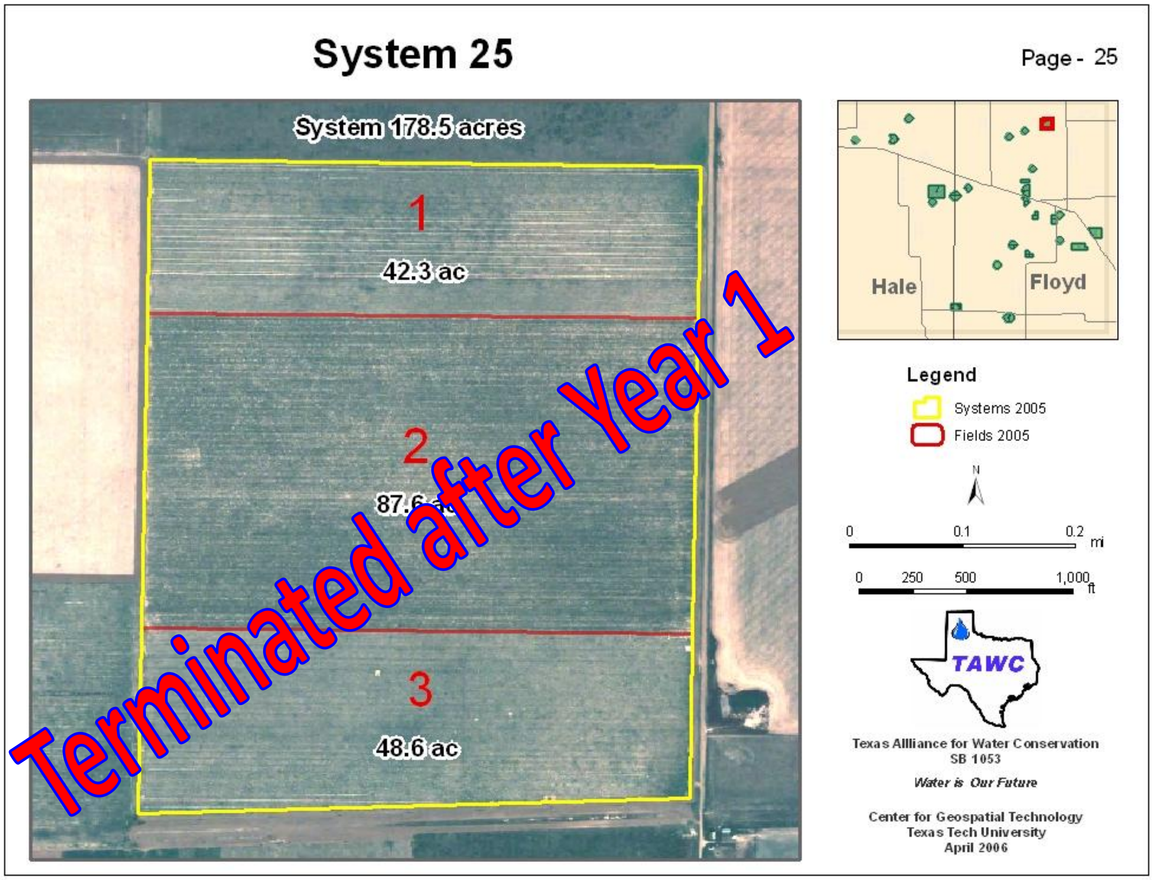
Irrigation and Precipitation
Water (inches)
50
40
30
20
10
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
600
500
400
300
200
100
0
2005
2006
2007
2008
2009
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
30
25
20
15
10
5
0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 25 Description

Total system acres: 178.5

Field No. 1 Acres: 42.3
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 87.6
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 3 Acres: 48.6
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Dryland

Pumping capacity, gal/min:

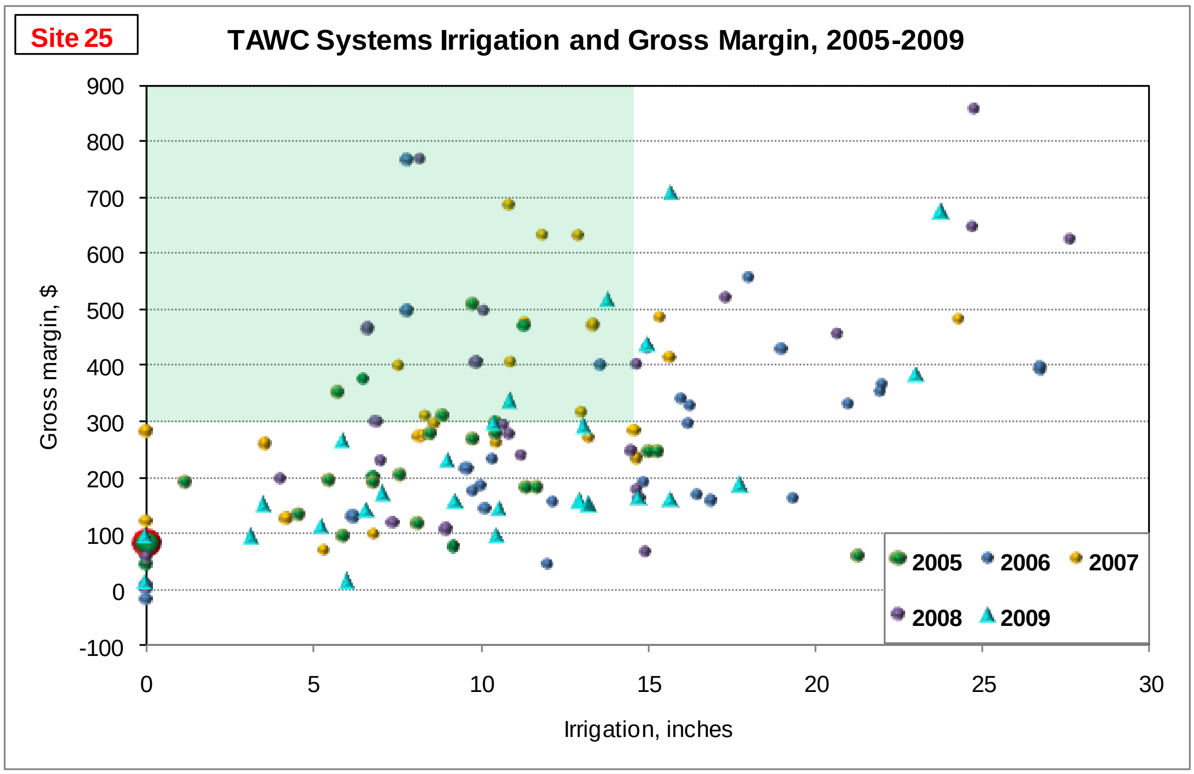
Number of wells:

Fuel source:

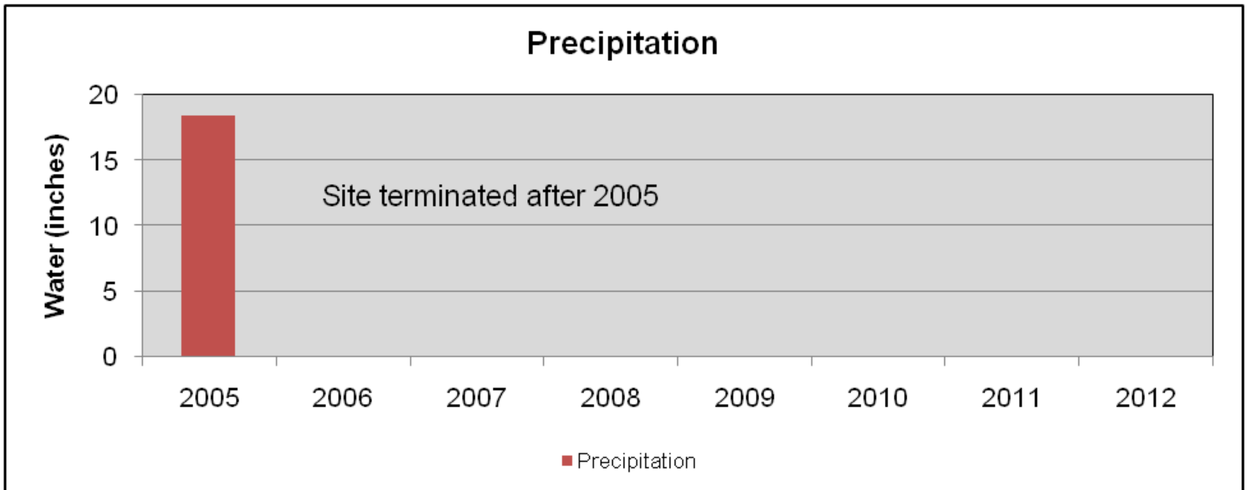
Comments: At this dryland site cotton and grain sorghum are grown in rotation. The cotton is planted in standing grain sorghum stalks. Cotton and grain sorghum are planted on forty-inch centers.

System 25

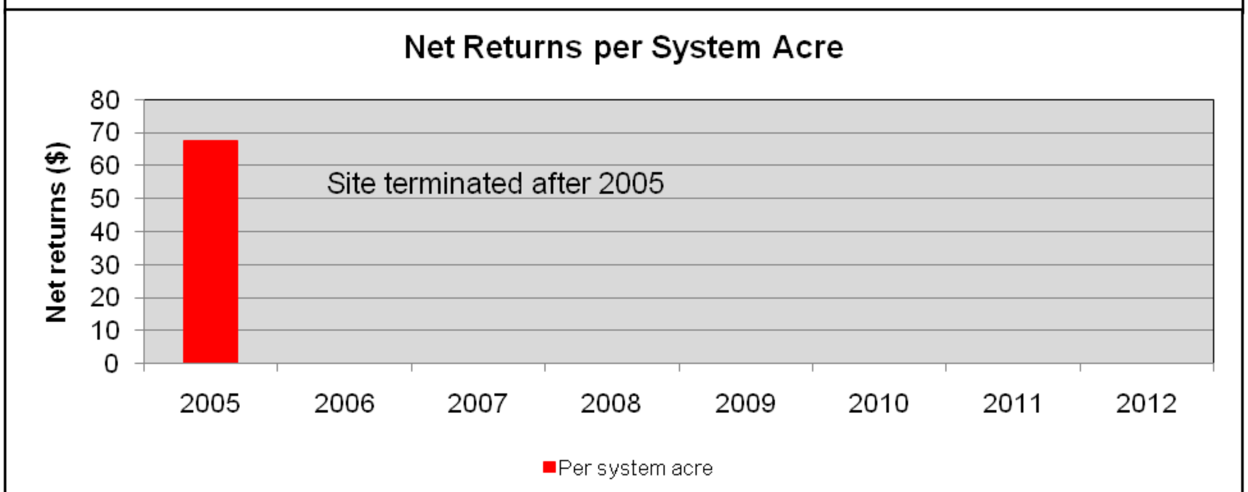
	Livestock	Field 1	Field 2	Field 3
2005	None	Cotton	Grain Sorghum	Cotton
2006	Site terminated in 2006			
2007				
2008				
2009				



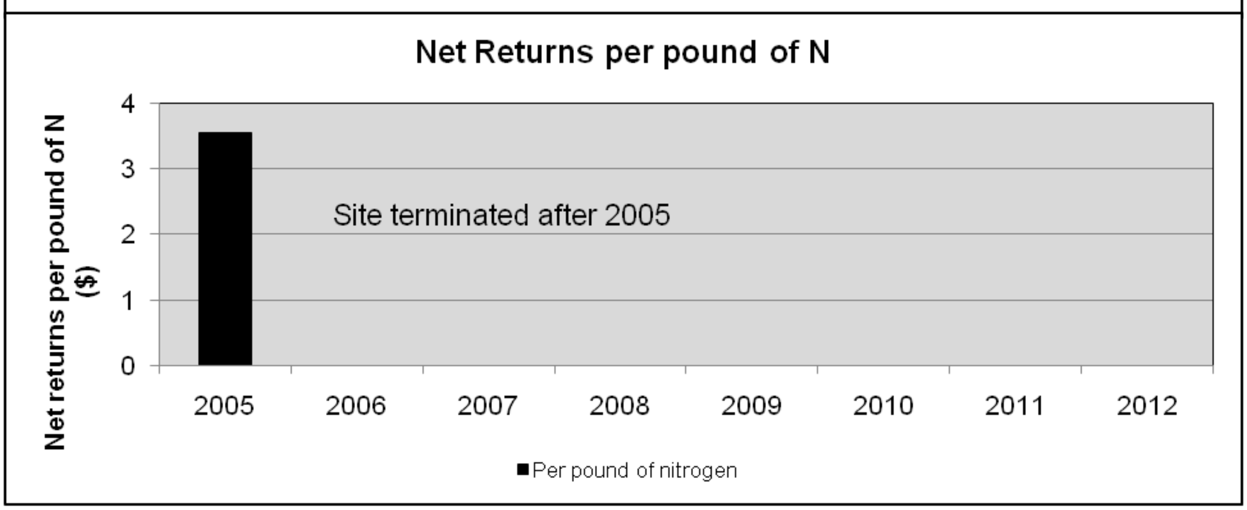
System 25



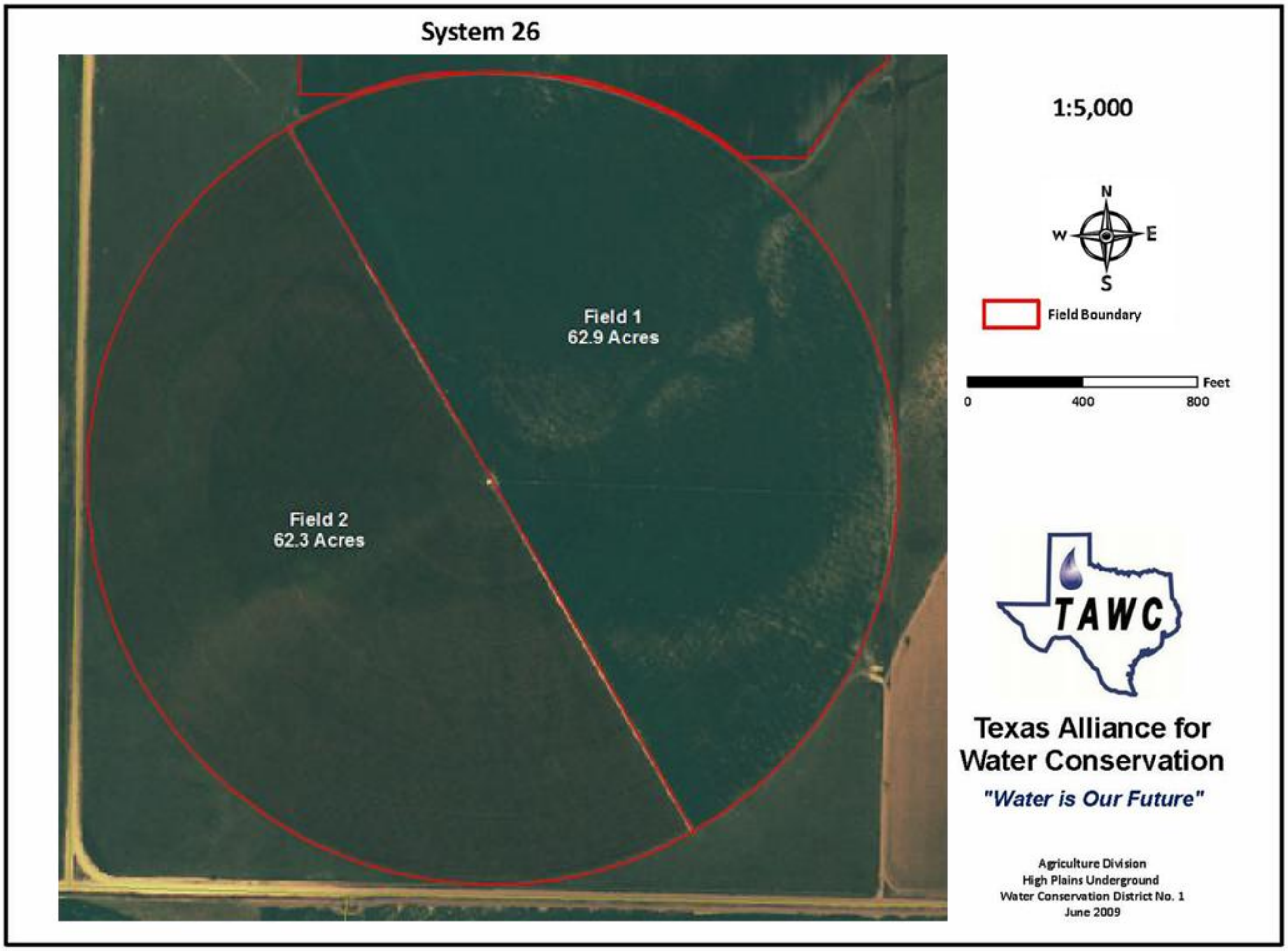
Precipitation
Water (inches)
20
15
10
5
0
Site terminated after 2005
2005
2006
2007
2008
2009
2010
2011
2012
Precipitation



Net Returns per System Acre
Net returns ($)
80
70
60
50
40
30
20
10
0
Site terminated after 2005
2005
2006
2007
2008
2009
2010
2011
2012
Per system acre



Net Returns per pound of N
Net returns per pound of N ($)
4
3
2
1
0
Site terminated after 2005
2005
2006
2007
2008
2009
2010
2011
2012
Per pound of nitrogen



System 26 Description

Total system acres: 125.2

Field No. 1 Acres: 62.9
Major soil type: Bippus loam; 0 to 3% slope
Mansker loam; 3 to 5% slope

Field No. 2 Acres: 62.3
Major soil type: Bippus loam; 0 to 3% slope
Mansker loam; 3 to 5% slope

Irrigation

Type: Center Pivot (LESA)

Pumping capacity, gal/min: 600

Number of wells: 2

Fuel source: 1 Electric
1 Diesel

Comments: This is a sunflower/white food corn system for 2009. In previous year's seed millet, cotton and grain sorghum for seed has been grown. This producer uses conventional tillage.

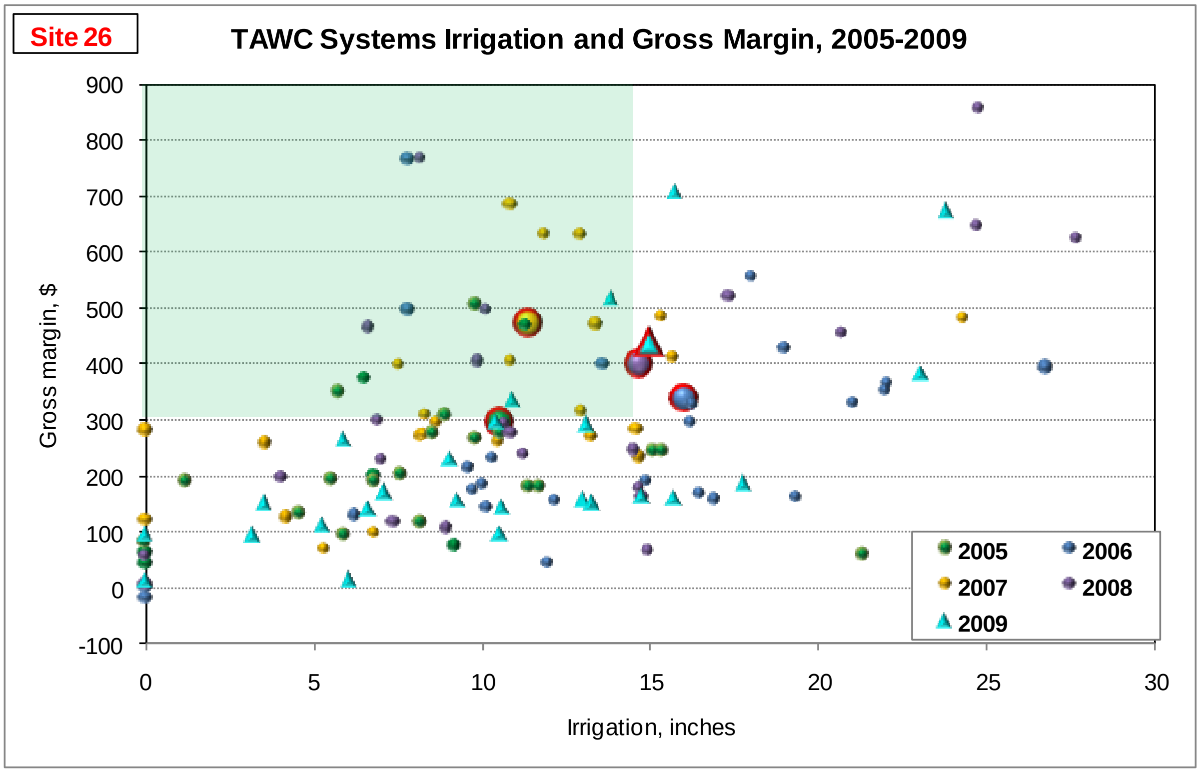
System 26

	Livestock	Field 1	Field 2	Field 3	Field 4
2005	None	Cotton	Corn for grain		
2006	None	Corn for grain	Cotton		
2007	Cow-calf	Pearlmillet for seed and grazing of residue	Corn for grain		
2008	Cow-calf	Split into Fields 3 and 4	Pearlmillet for seed and grazing of residue	Grain Sorghum for seed and grazing of residue	Corn for grain and grazing of residue
2009	Stocker	Sunflowers	Corn	Combined to make field 1	

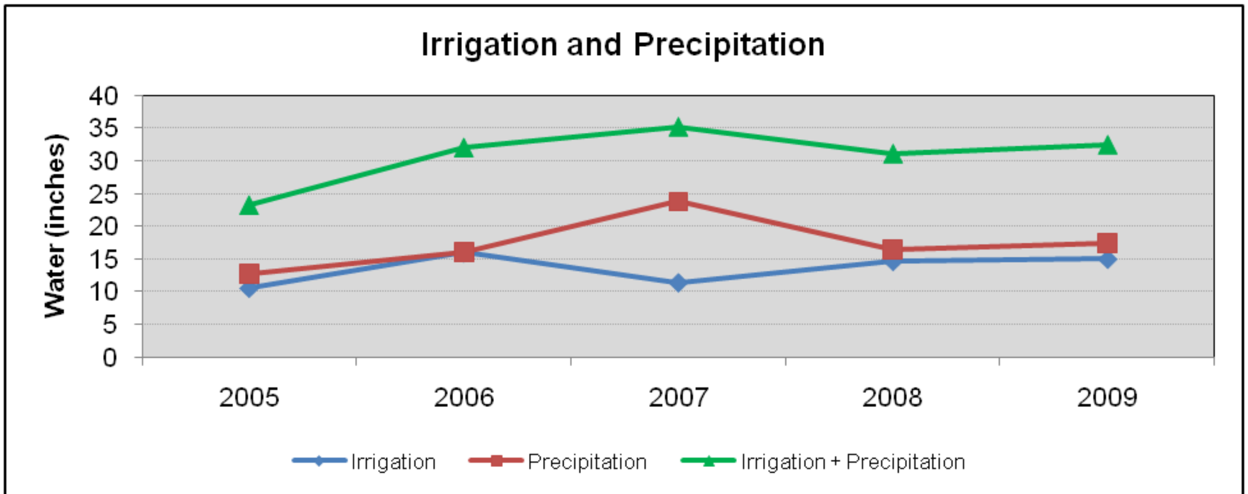
Site 26, Field 1 (July 2009)

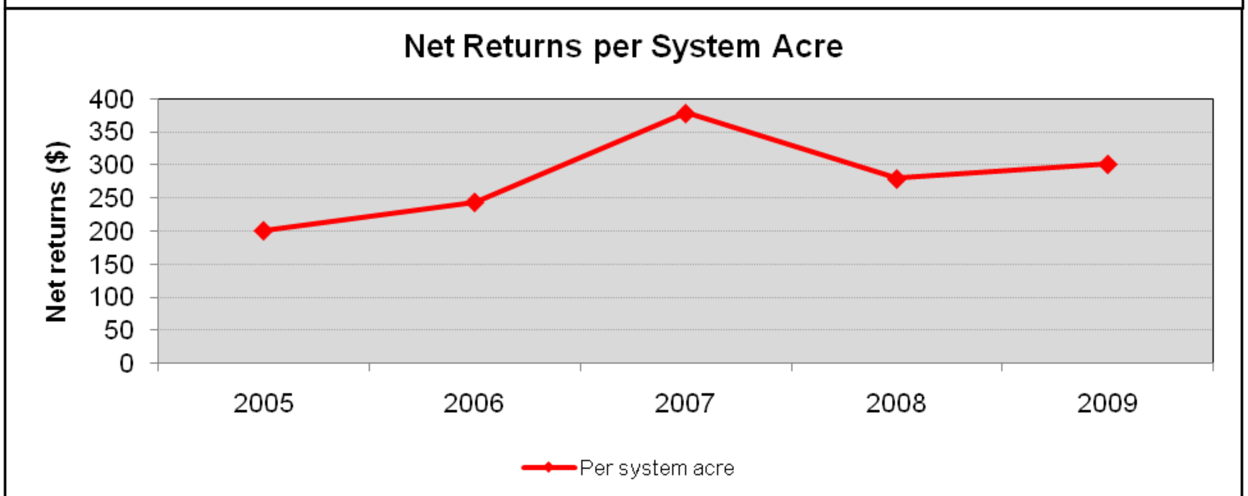
Site 26, Field 2 (July 2009)

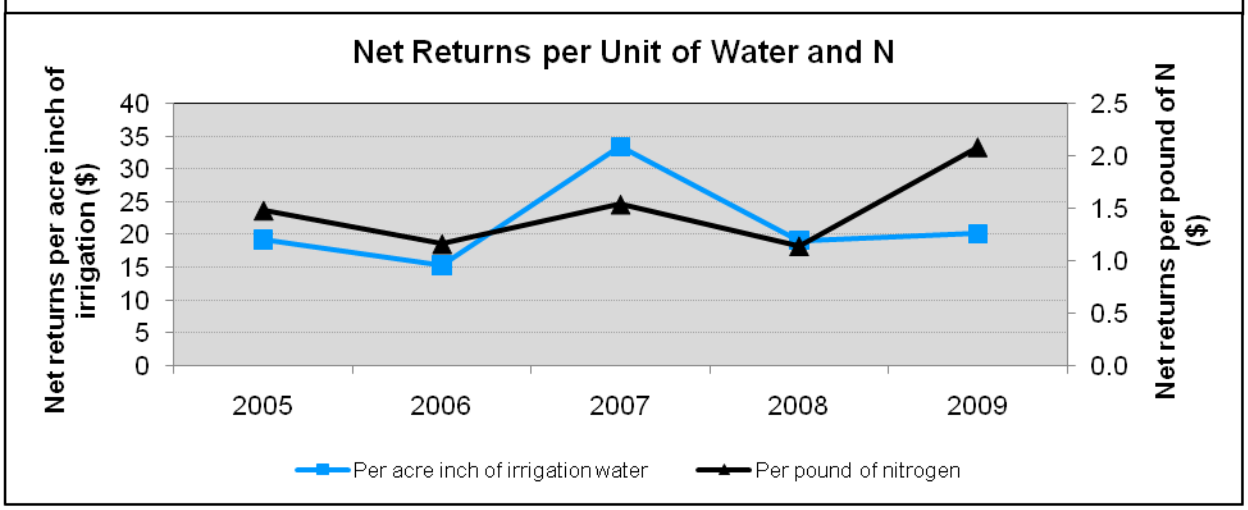
Site 26 (July 2009)

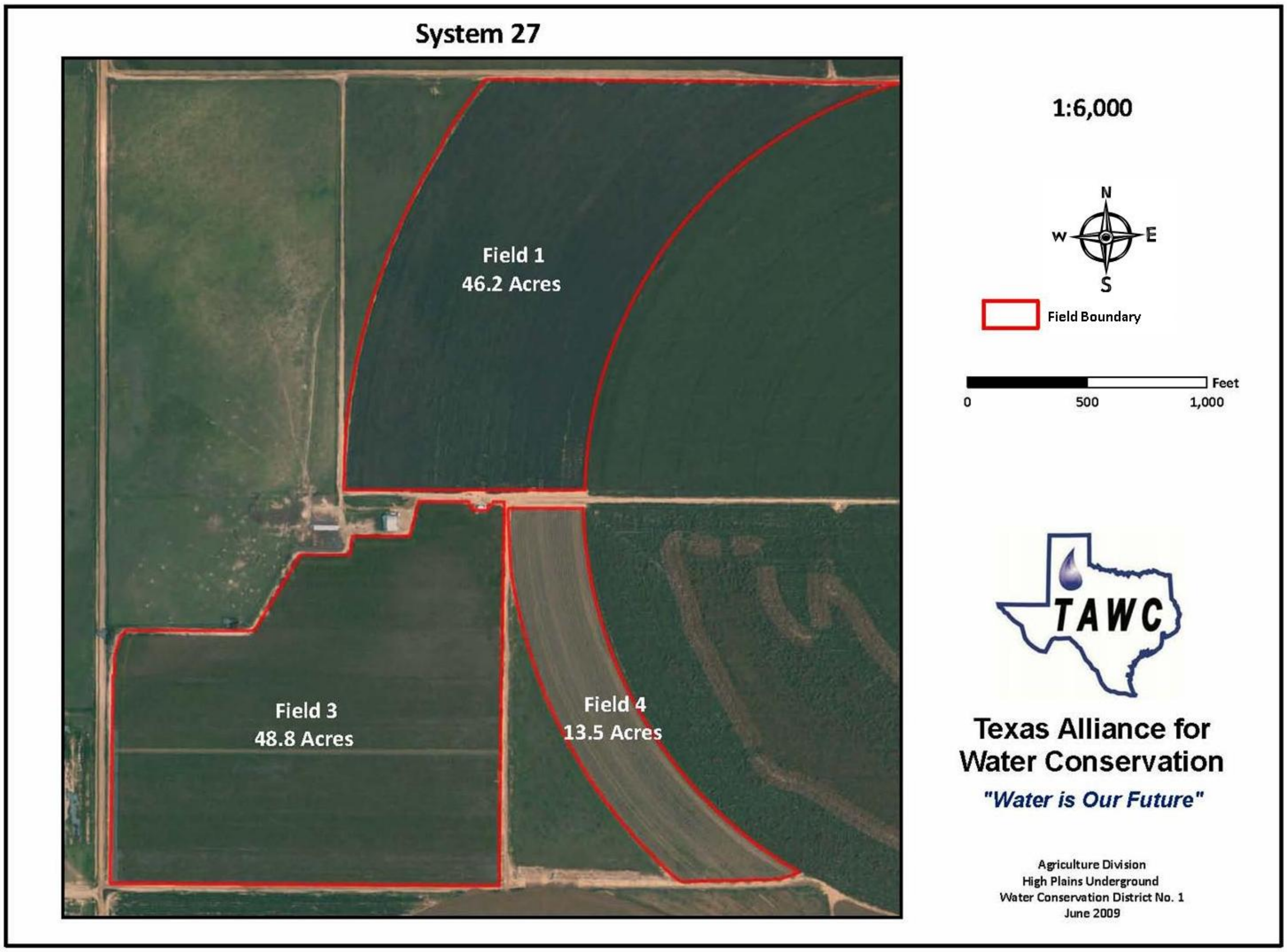

Site 26
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 26


Irrigation and Precipitation
Water (inches)
40
35
30
25
20
15
10
5
0
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
400
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
40
35
30
25
20
15
10
5
0
2.5
2.0
1.5
1.0
0.5
0.0
Net returns per pound of N ($)
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 27 Description

Total system acres: 108.5

Field No. 1 Acres: 46.2
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 3 Acres: 48.8
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 4 Acres: 13.5
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Sub-surface Drip
(SDI, installed prior to 2006 crop year)
Pumping capacity, gal/min: 400

Number of wells: 2

Fuel source: Electric

Comments: This is the third year for this cotton/corn drip irrigated site. Corn is planted on twenty-inch centers with cotton planted on forty-inch centers using conventional tillage.

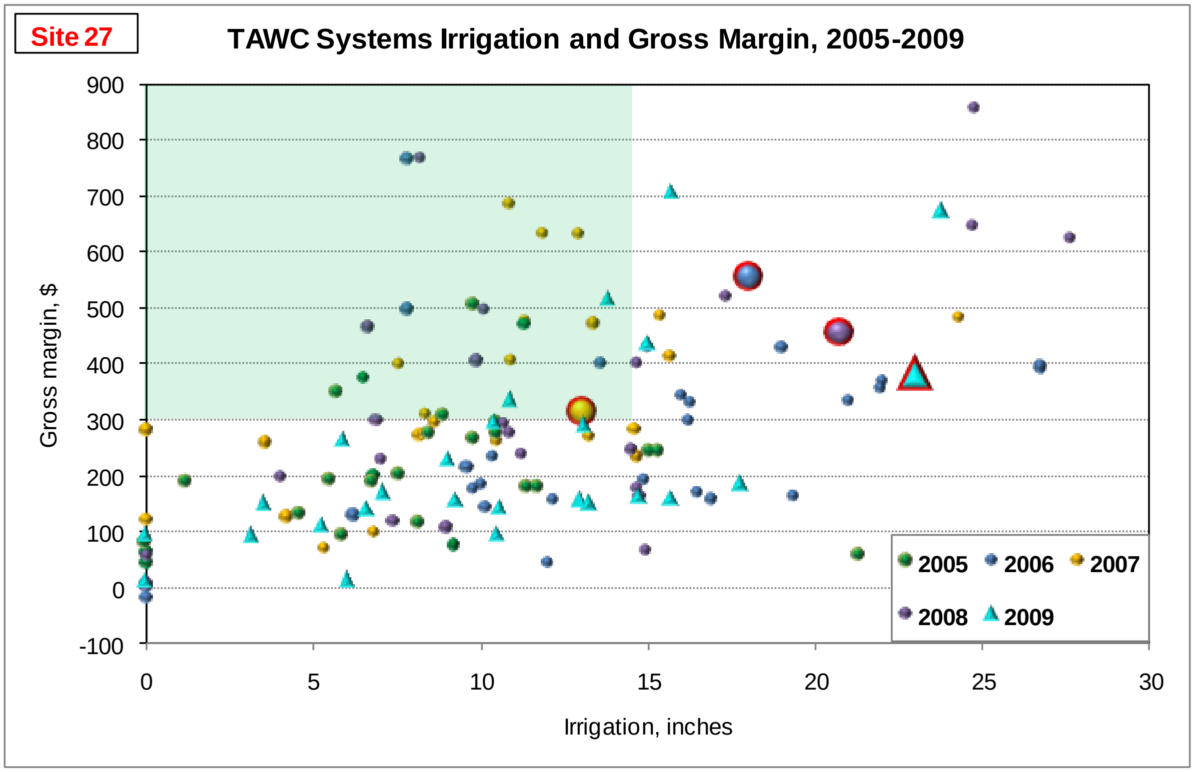
System 27

	Livestock	Field 1	Field 2	Field 3	Field 4
2005	Entered project in Year 2				
2006	None	Cotton following Wheat cover crop			
2007	None	Corn for silage	Cotton following Wheat cover crop		
2008	None	Cotton following wheat cover crop	Additional acres added to create Field 3	Corn for grain	Corn for grain – high moisture
2009	None	Corn for silage		Cotton	Corn for silage

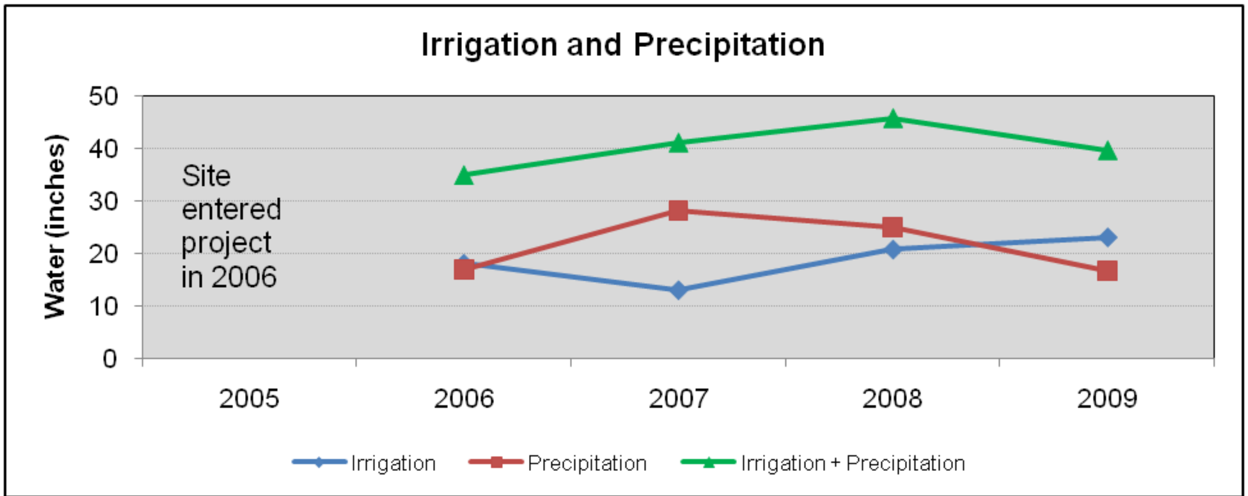
Site 27, Field 1 (May 2009)

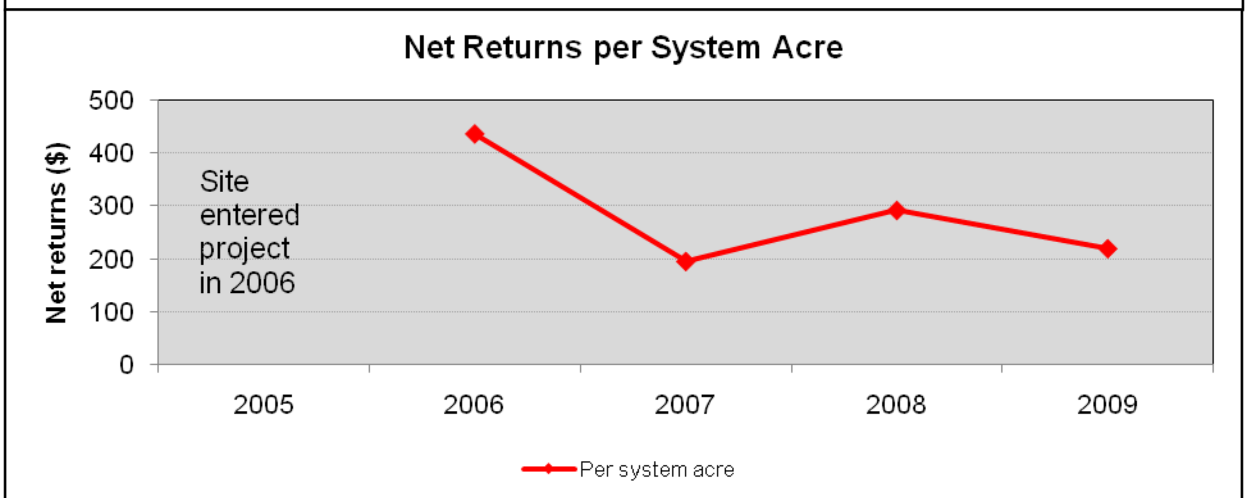
Site 27, Field 3 (September 2009)

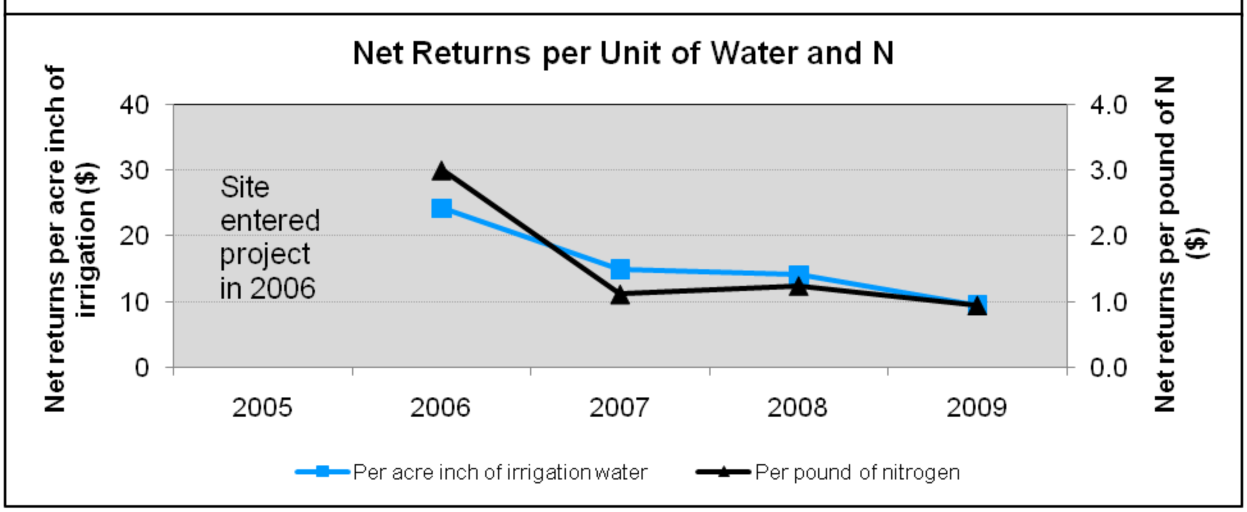
Site 27, Field 4 (August 2009)

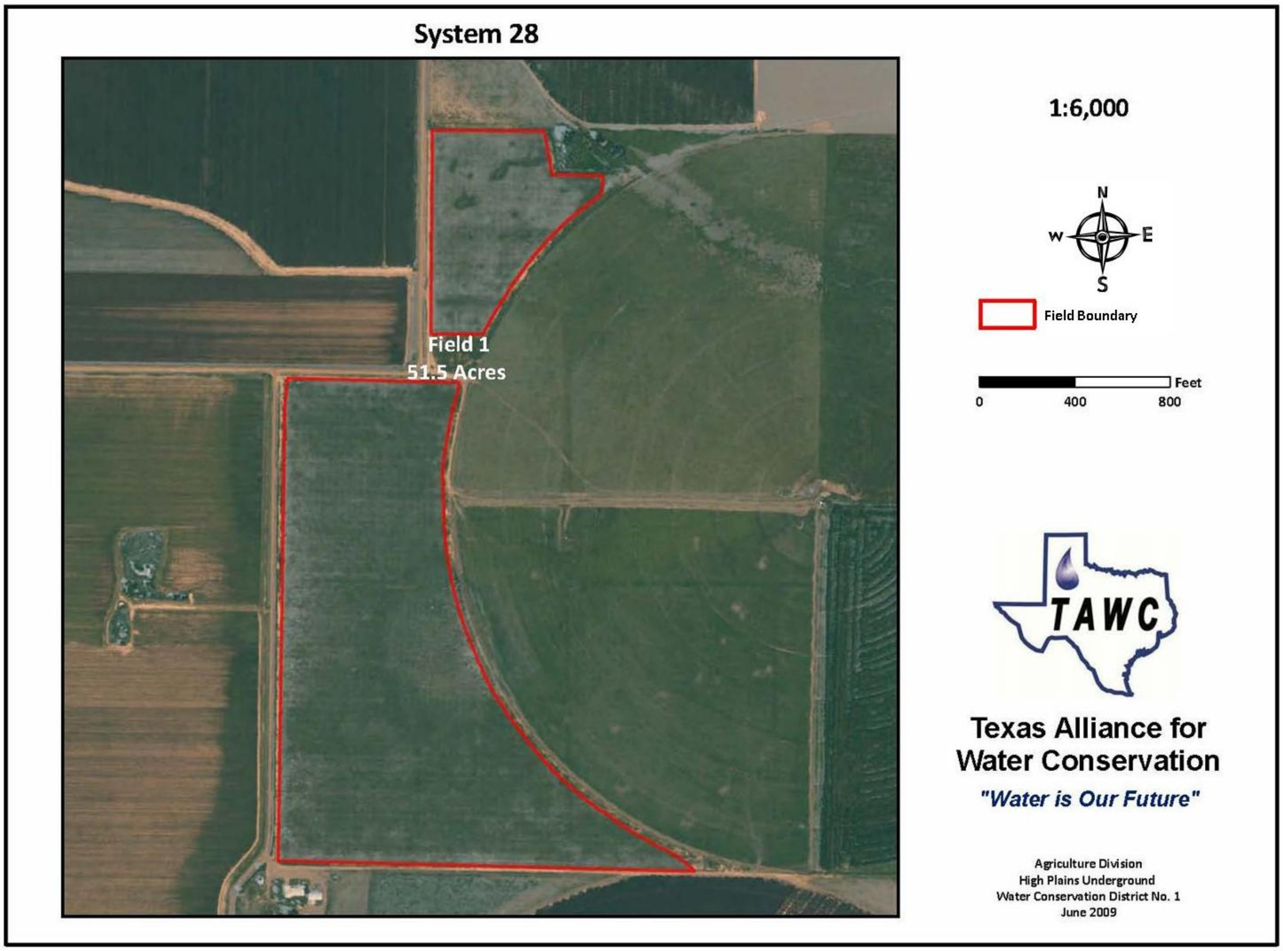

Site 27
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 27


Irrigation and Precipitation
Water (inches)
0
10
20
30
40
50
Site entered project in 2006
2005
2006
2007
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
0
100
200
300
400
500
Site entered project in 2006
2005
2006
2007
2008
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
0
10
20
30
40
Net returns per pound of N ($)
0.0
1.0
2.0
3.0
4.0
Site entered project in 2006
2005
2006
2007
2008
2009
Per acre inch of irrigation water
Per pound of nitrogen



System 28 Description

Total system acres: 51.5

Field No. 1 Acres: 51.5
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Sub-surface Drip (SDI)

Pumping capacity, gal/min: 300

Number of wells: 1

Fuel source: electric

Comments: This is the second year for this drip irrigated site which was planted to cotton on forty-inch centers.

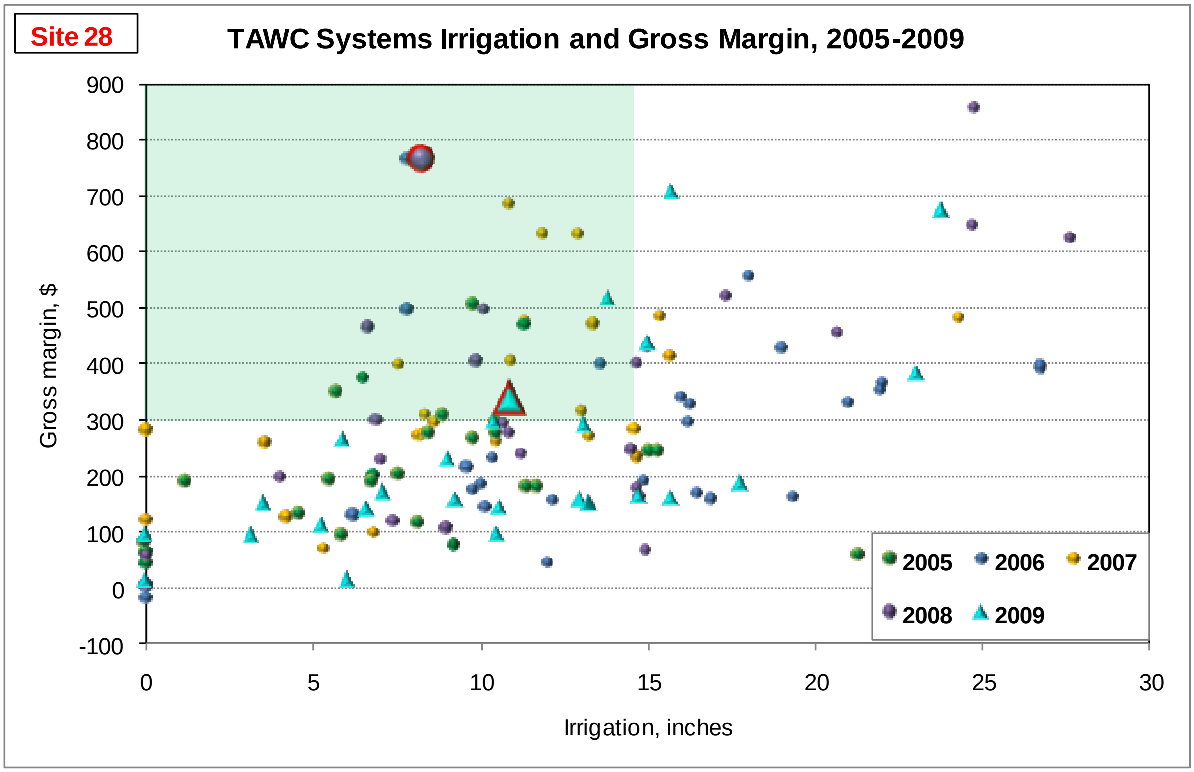
System 28

	Livestock	Field 1
2005	Entered project in Year 4	
2006		
2007		
2008	None	Corn for grain
2009	None	Cotton

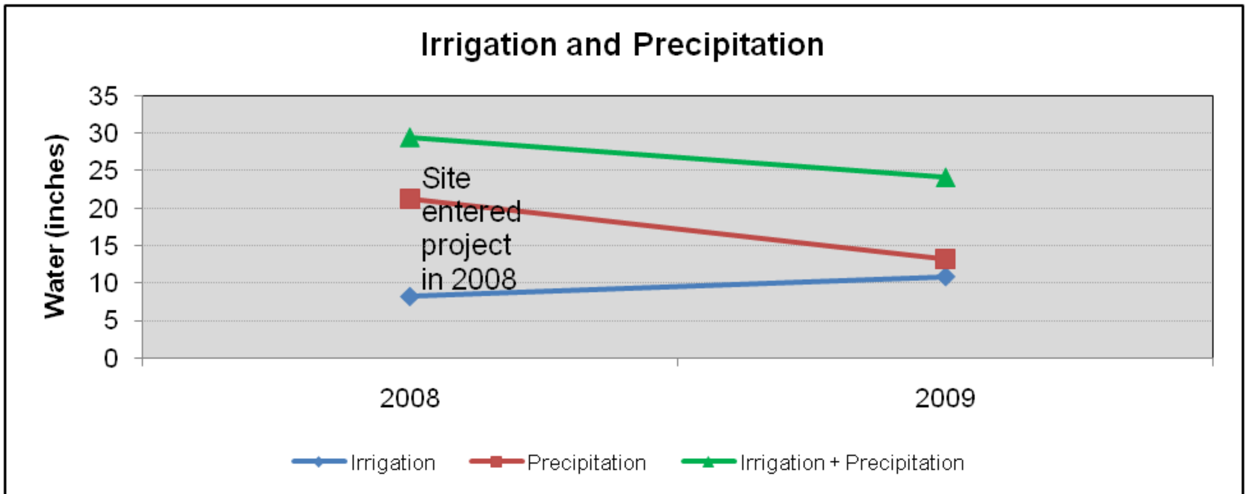
Site 28, Field 1 (May 2009)

Site 28, Field 1 (July 2009)

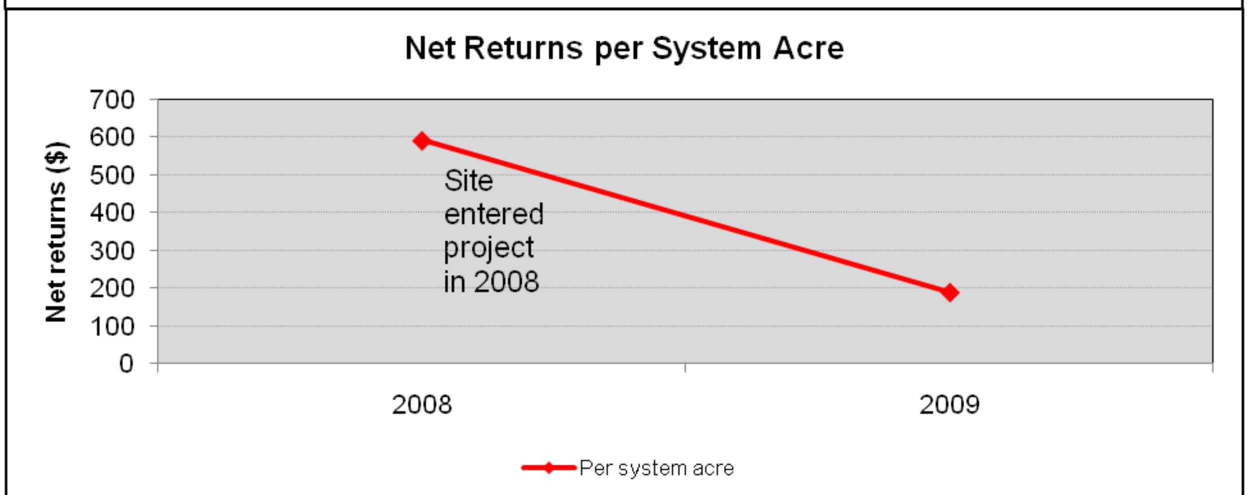
Site 28, Field 1 (September 2009)


Site 28
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

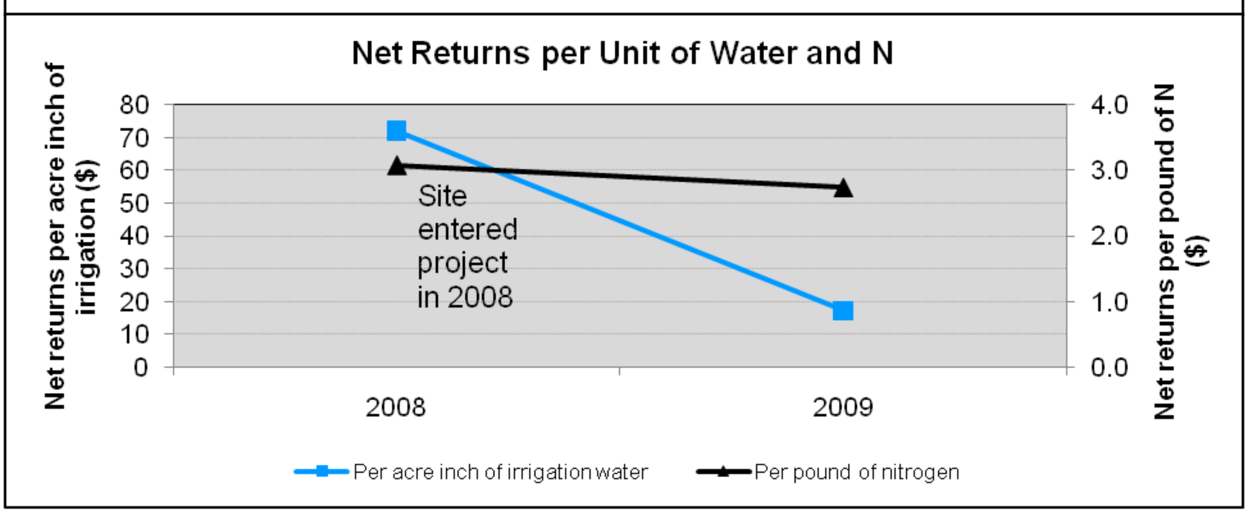
System 28



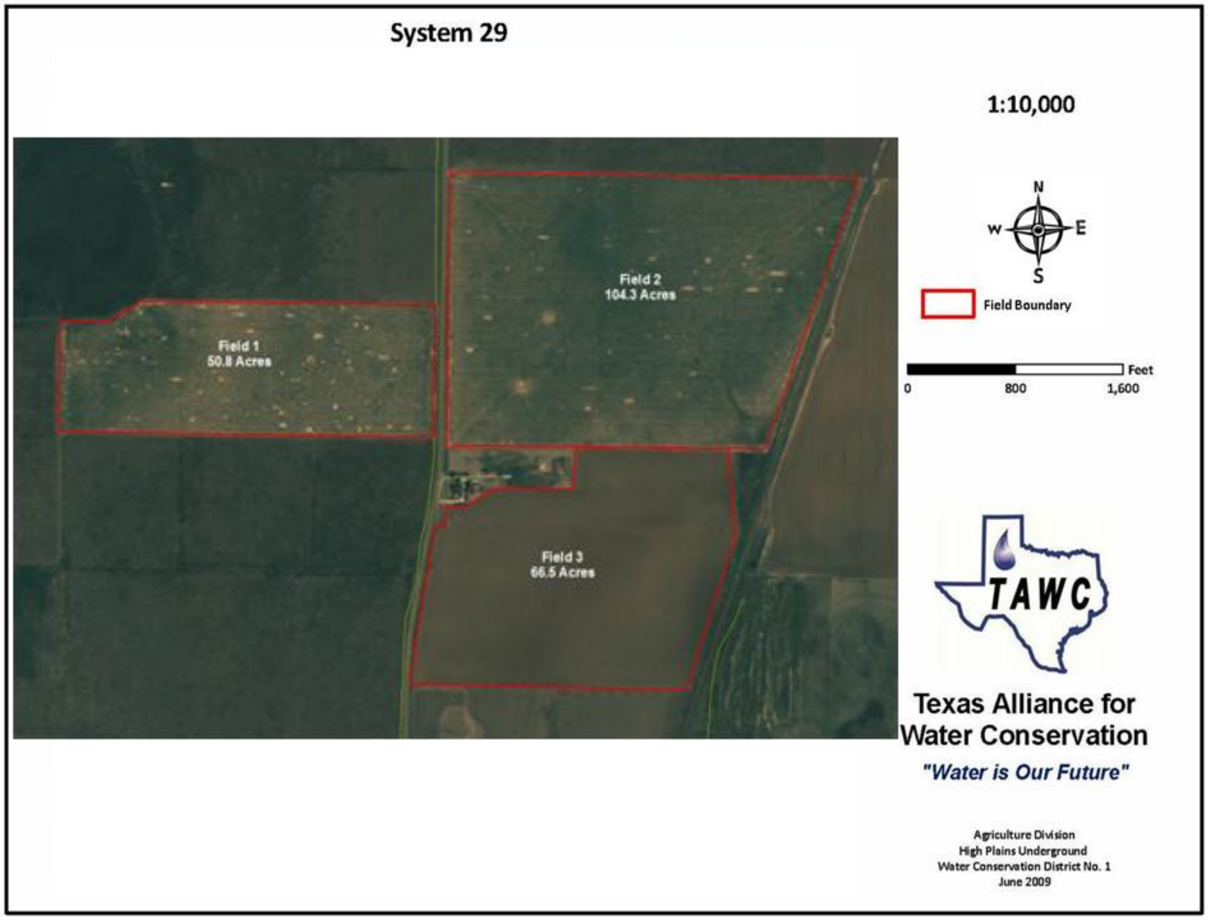
Irrigation and Precipitation
Water (inches)
35
30
25
20
15
10
5
0
Site entered project in 2008
2008
2009
Irrigation
Precipitation
Irrigation + Precipitation



Net Returns per System Acre
Net returns ($)
700
600
500
400
300
200
100
0
Site entered project in 2008
2008
2009
Per system acre



Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
80
70
60
50
40
30
20
10
0
Site entered project in 2008
2008
2009
4.0
3.0
2.0
1.0
0.0
Net returns per pound of N ($)
Per acre inch of irrigation water
Per pound of nitrogen



System 29 Description

Total system acres: 220.7

Field No. 1 Acres: 50.8
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 2 Acres: 104.3
Major soil type: Pullman clay loam; 0 to 1% slope

Field No. 3 Acres: 65.6
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Dryland

Pumping capacity, gal/min:

Number of wells:

Fuel source:

Comments: This is a conventional till dryland site using cotton and wheat rotation program. Cotton is planted on forty-inch rows.

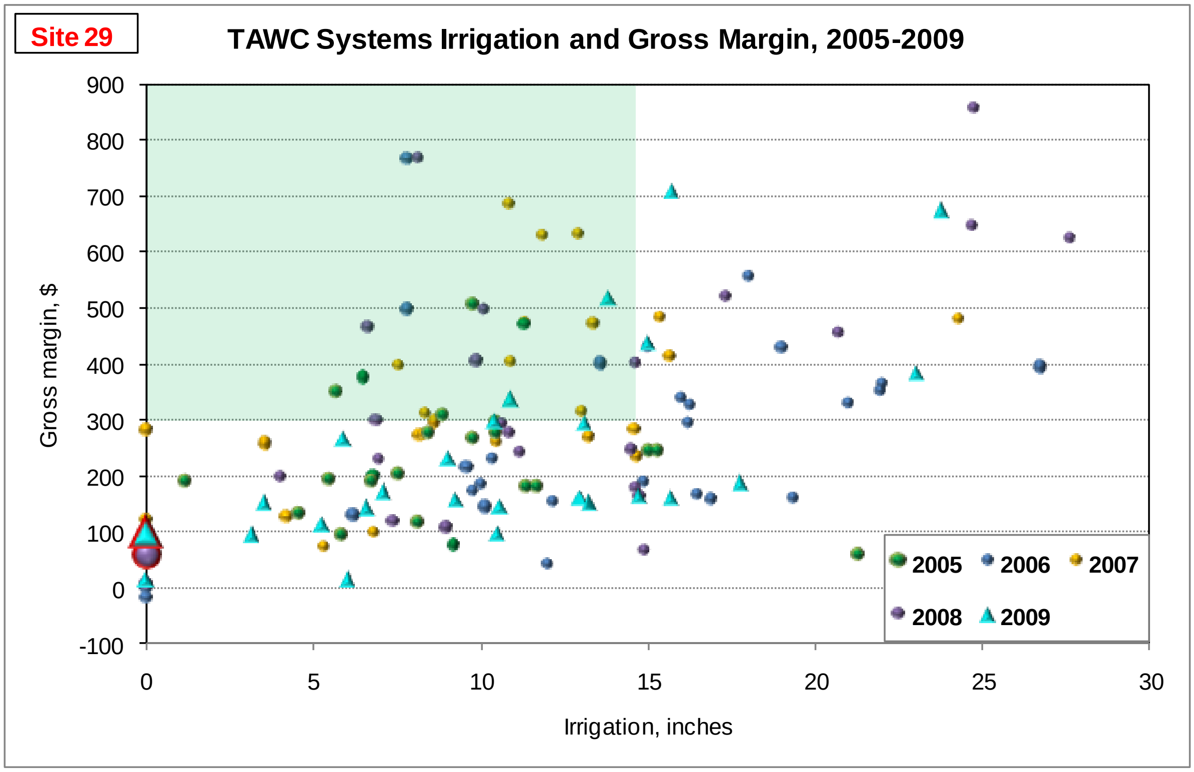
System 29

	Livestock	Field 1	Field 2	Field 3
2005	Entered project in Year 4			
2006				
2007				
2008	None	Cotton following Wheat cover crop	Fallow, followed by Wheat for cover and grazing	Cotton following Wheat cover crop
2009	None	Cotton	Wheat	Cotton

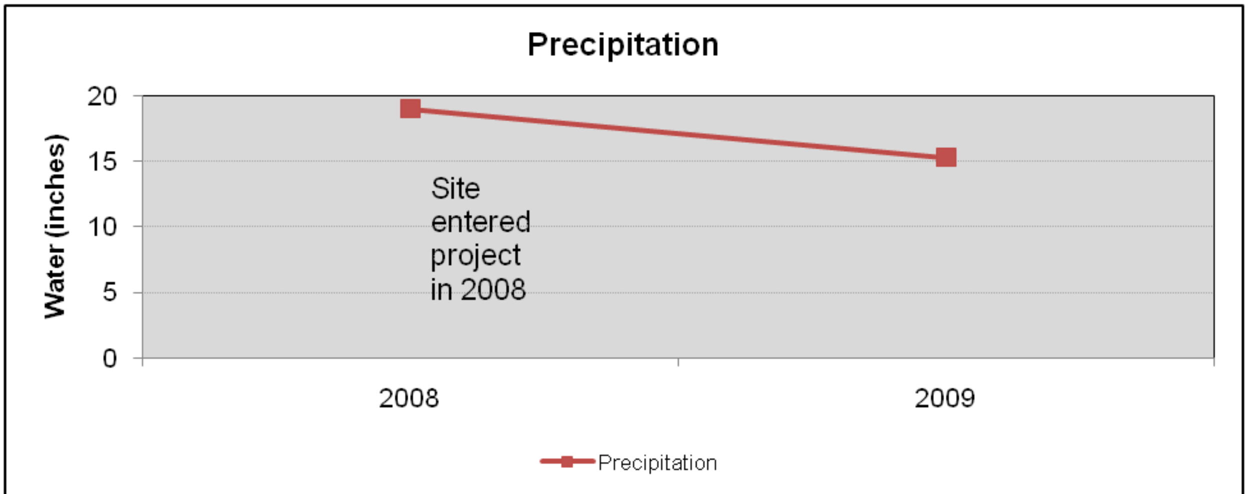
Site 29, Field 1 (May 2009)

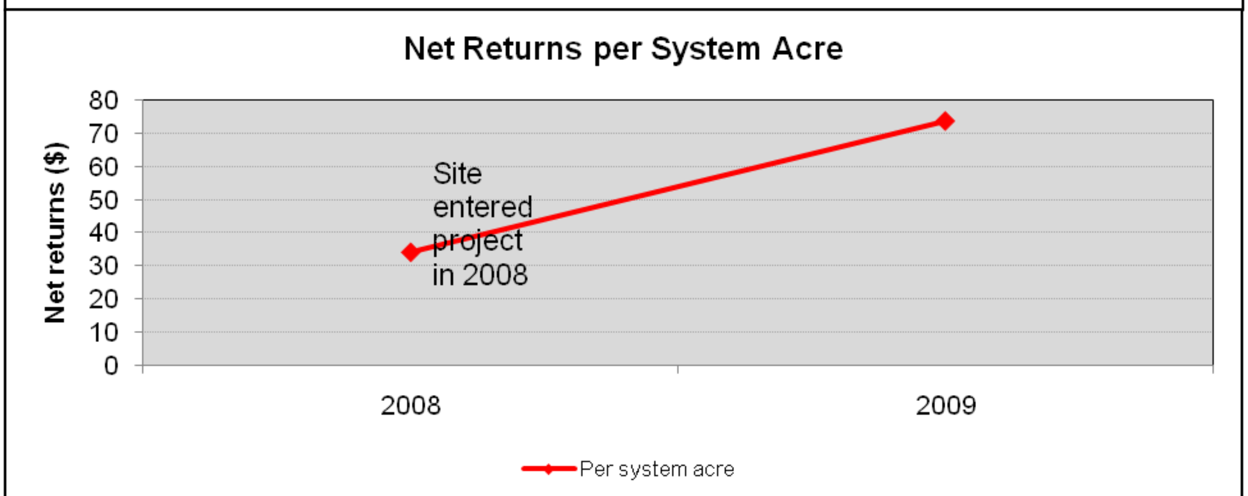
Site 29, Field 2 (May 2009)

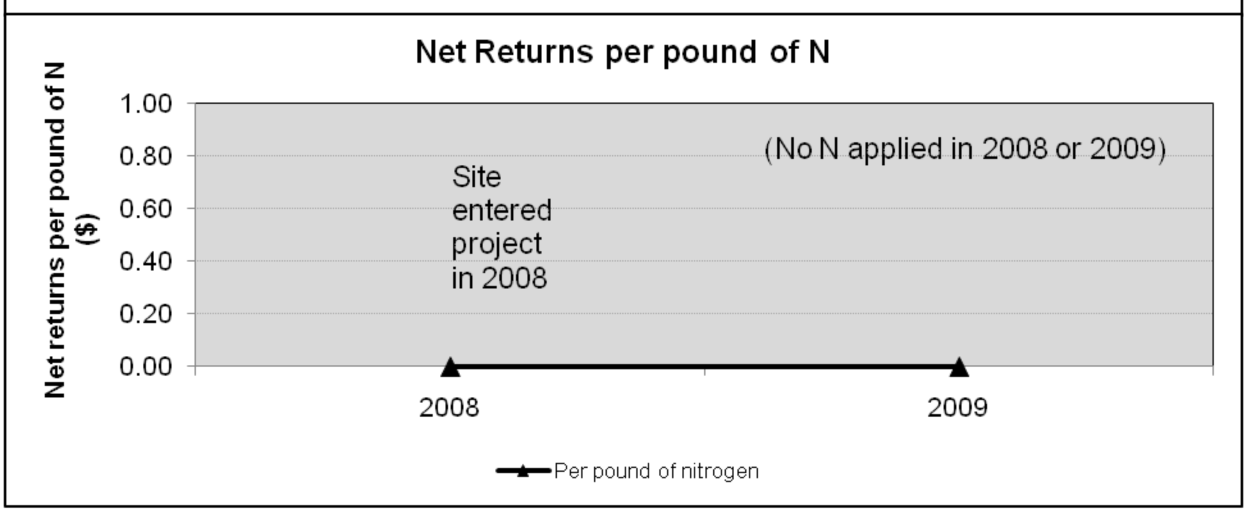
Site 29, Field 3 (May 2009)

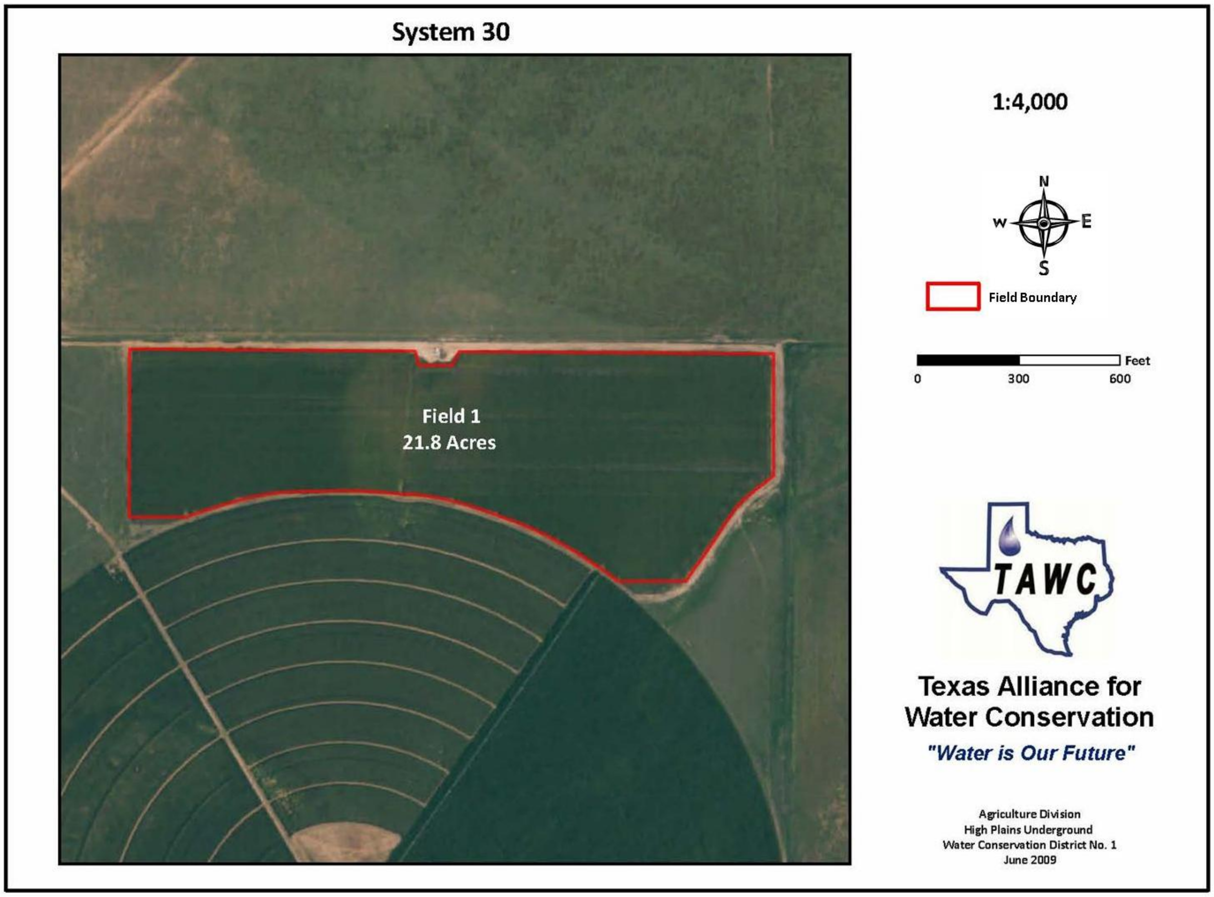

Site 29
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
Irrigation, inches
2005
2006
2007
2008
2009

System 29


Precipitation
Water (inches)
20
15
10
5
0
Site entered project in 2008
2008
2009
Precipitation


Net Returns per System Acre
Net returns ($)
80
70
60
50
40
30
20
10
0
Site entered project in 2008
2008
2009
Per system acre


Net Returns per pound of N
Net returns per pound of N ($)
1.00
0.80
0.60
0.40
0.20
0.00
(No N applied in 2008 or 2009)
Site entered project in 2008
2008
2009
Per pound of nitrogen



System 30 Description

Total system acres: 21.8

Field No. 1 Acres: 21.8
Major soil type: Pullman clay loam; 0 to 1% slope

Irrigation

Type: Sub-surface Drip (SDI)

Pumping capacity, gal/min: 150

Number of wells: 1

Fuel source: Electric

Comments: This site is drip irrigated and was planted to sunflowers on twenty-inch centers using conventional tillage.

System 30

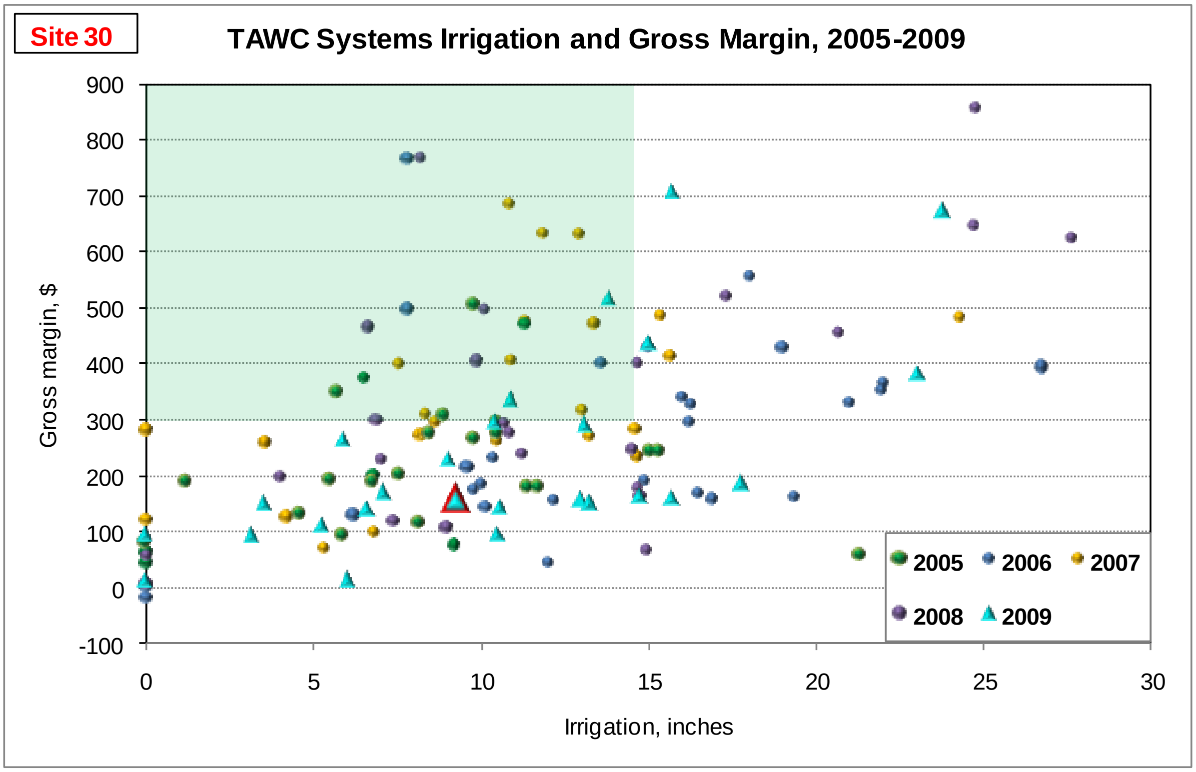
	Livestock	Field 1
2005	Entered project in Year 5	
2006		
2007		
2008		
2009	None	Sunflowers

Site 30, Field 1 (May 2009)

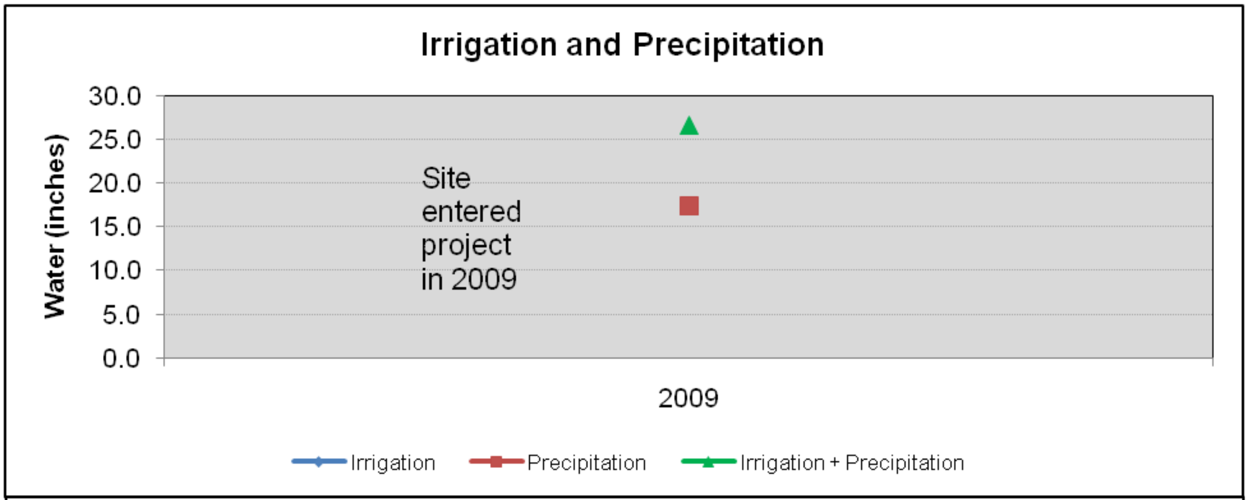
Site 30, Field 1 (May 2009)

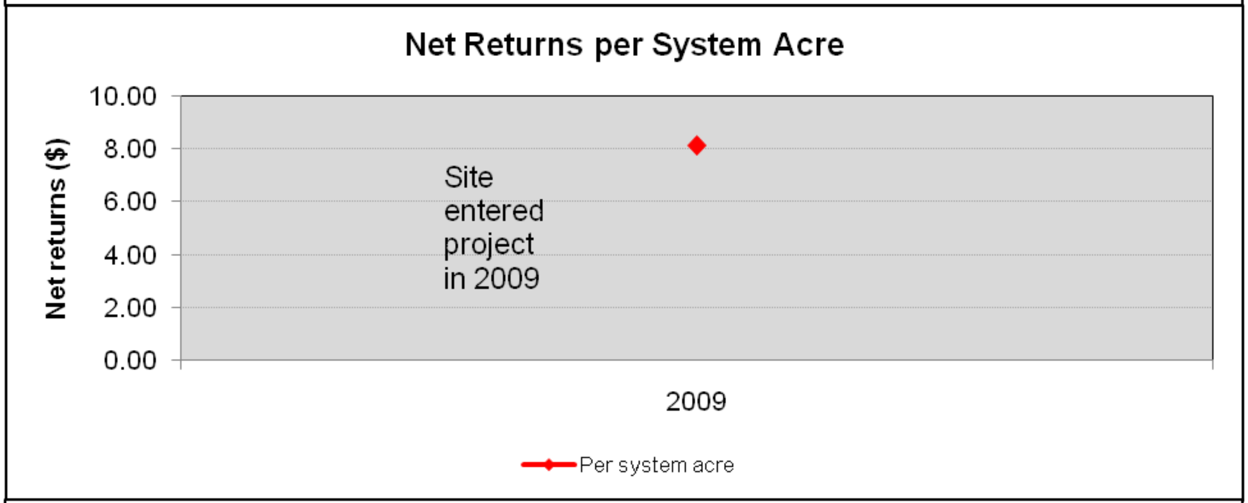
Site 30, Field 1 (July 2009)

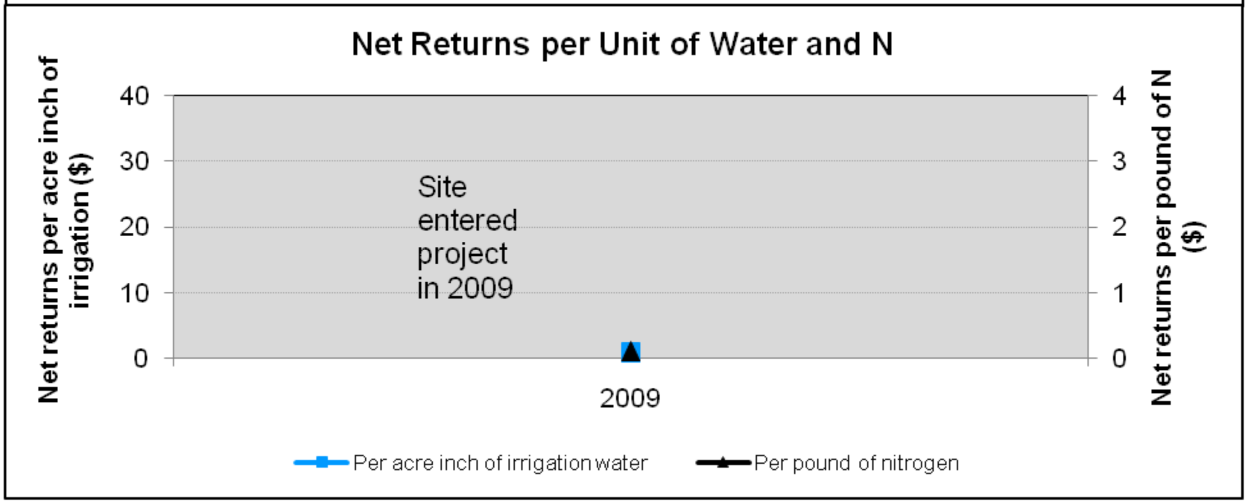
Site 30, Field 1 (July 2009)


Site 30
TAWC Systems Irrigation and Gross Margin, 2005-2009
Gross margin, $
Irrigation, inches
900
800
700
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
2005
2006
2007
2008
2009

System 30


Irrigation and Precipitation
Water (inches)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Site entered project in 2009
2009
Irrigation
Precipitation
Irrigation + Precipitation


Net Returns per System Acre
Net returns ($)
10.00
8.00
6.00
4.00
2.00
0.00
Site entered project in 2009
2009
Per system acre


Net Returns per Unit of Water and N
Net returns per acre inch of irrigation ($)
40
30
20
10
0
Site entered project in 2009
2009
4
3
2
1
0
Net returns per pound of N ($)
Per acre inch of irrigation water
Per pound of nitrogen

OVERALL SUMMARY OF YEARS 1—5

The 2009 year was unusually dry with precipitation averaging only 15.2 inches across the Demonstration sites (Fig. 5; Table 8). Precipitation over the 5 years of the project ranged from a low of 14.9 inches (2005) to a high of 27.0 inches (2007). In spite of the lack of rainfall, total irrigation water applied over the irrigated sites averaged 11.5 inches; 0.58 inches less than the mean of irrigation applied over the previous 4 years of this project. Furthermore, over the past 3 years, total irrigation applied per system acre was relatively constant in spite of an almost linear decline in precipitation from 27 to 15.1 inches (Figure 9).

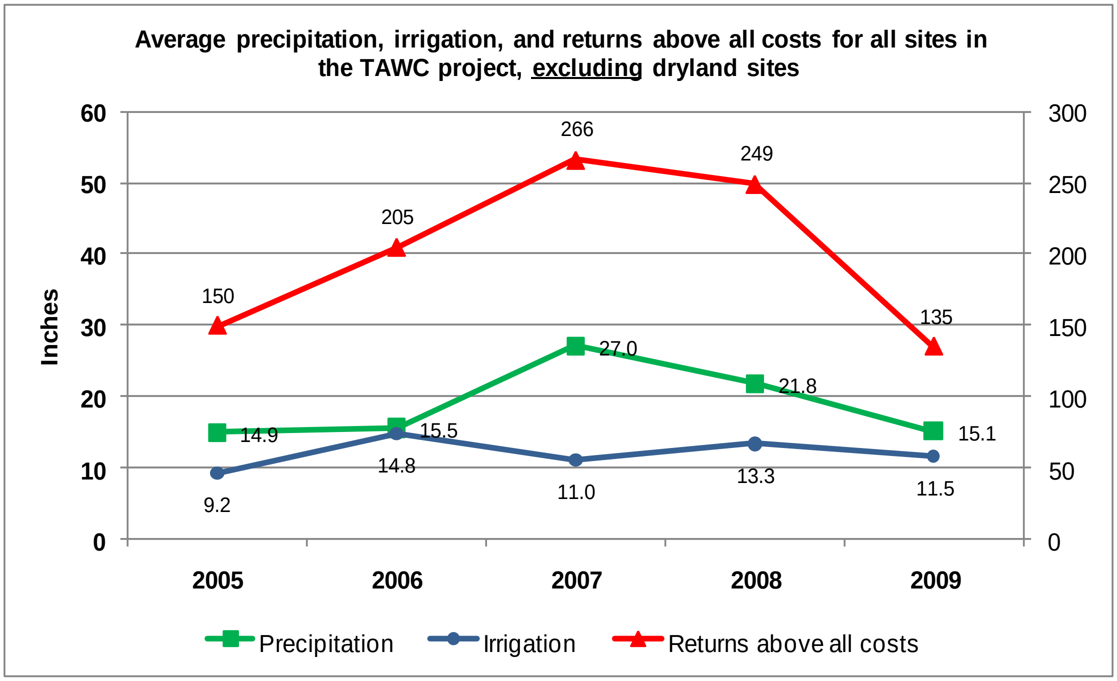


Figure 9. Average precipitation, irrigation and returns above all costs for all sites in the TAWC project, excluding dryland sites.

When all acres of all systems (both dryland and irrigated systems) were included, irrigation water applied over the entire project area averaged 10.6 inches (Fig. 10).

Profitability in 2009 reflected lower total moisture that was not offset, on average, by additional irrigation (Fig. 9). Additionally, prices for cattle, corn, and cotton, based on grade, were lower than the 2008 prices. Wheat prices declined compared with 2008 but were higher than had been experienced during the earlier years of the project. While cotton prices in general were similar to previous years, quality of cotton was lower reflecting the lower temperatures experienced during September. The lack of heat units during this period negatively affected cotton quality harvested in the Demonstration area and this was reflected in lower prices received by these producers. On the other hand, prices paid by producers for electricity decreased in 2009 compared with 2008, as noted earlier. This was primarily due to decreased oil prices and helped reduce their overall cash expenses.

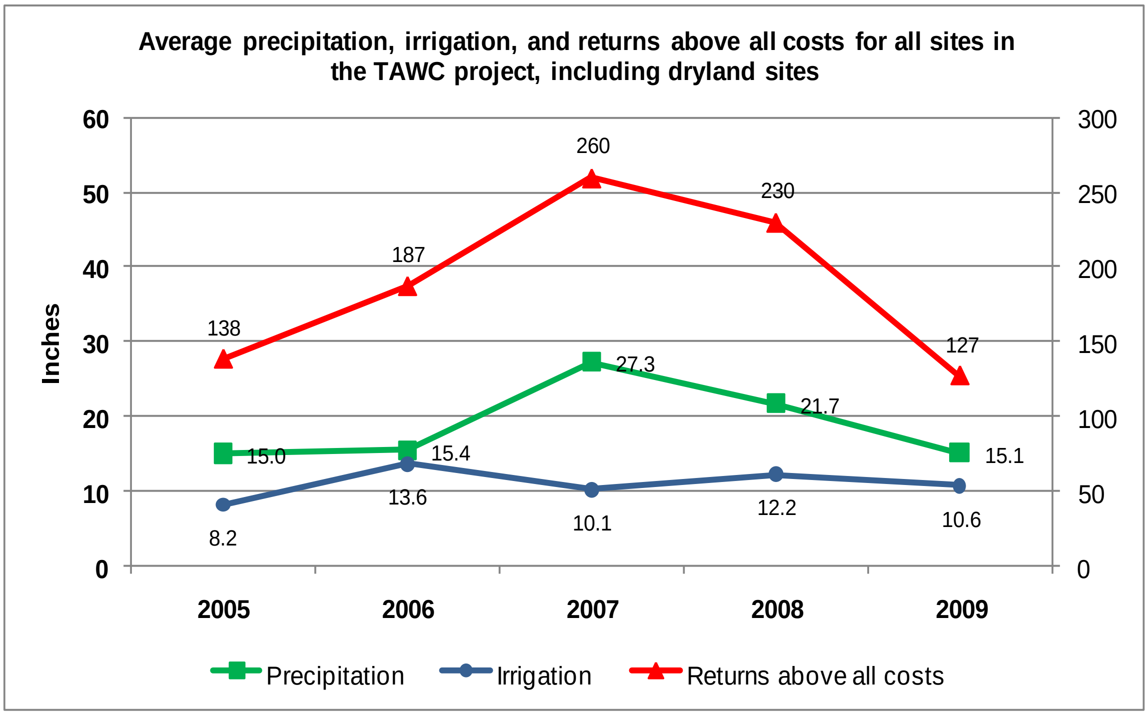


Figure 10. Average precipitation, irrigation, and returns above all costs for all sites in the TAWC project, including dryland sites.

Other factors affecting profitability in 2009 included continued higher prices for fertilizers and fuels – anything relating to energy inputs. Although prices were lower compared with those experienced in 2008, they remained elevated over previous years and influenced decisions and perceptions of risk. Prices for corn seed and cotton seed also increased for the 2009 crop year. Across the Demonstration sites, cotton acres increased by about 400 acres while land planted to corn decreased by about 300 acres (Fig. 11). Numbers of acres of sorghum (grain and forage) decreased as well as did small grain acres.

Some cropping decision changes occurred to allow herbicide and cultivation options to address increasing weed problems. Some changes likely reflected anticipated decreases in corn prices which when combined with anticipated high costs for fertilizers, made corn a less attractive option. Furthermore, soil moisture was low. No precipitation had occurred in the previous November and December (Fig. 4) and with a moisture deficit continuing through the May planting season (Fig. 5). Corn requires more water to produce a crop than does cotton. Cotton replaced corn in one system (Site 22) that accounted for about half of the total increase in cotton acres. Cotton replaced other crops in five additional systems where the previous crops included sunflowers, alfalfa, grain sorghum, and a wheat/forage sorghum rotation.

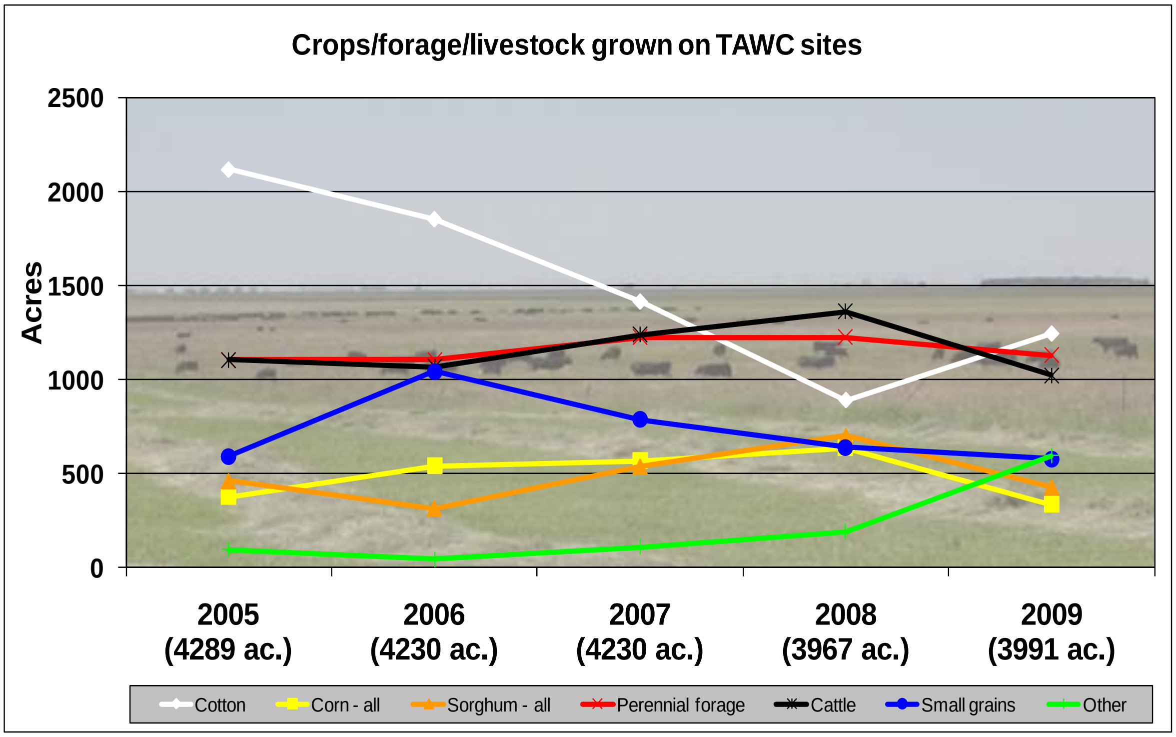


Figure 11. Number of acres that include cotton, corn, sorghum, perennial forages, cattle, small grains and other crops within the producer systems located in Hale and Floyd Counties.

Through 2009, producers have made all decisions on cropping and livestock practices. This has allowed us to monitor closely the impact of their decisions on allocation of land to various crops, forages, and livestock enterprises. Commodity and input prices, loan availability, risk, issues of land ownership, government policies, and other factors influence their decisions. When this project began in 2005, cotton dominated the landscape both in terms of the number of total acres in production and the number of sites that included cotton in their system, either as a monoculture or as a component of the system (Fig. 11 and 12). Between 2005 and 2008, cotton acres declined to less than half of the acres present originally (Fig. 11). By 2008, there were only about half of the original number of sites that included cotton (Fig. 12). In 2009, however, cotton acres increased as did the number of sites that included cotton in their system. This increase was largely in response to anticipated improvements in prices and a declining market and profit margin for grains. Sorghum, corn and small grain acres all declined in 2009. Total number of acres in perennial forages was similar to cotton acres in 2009. Together, these two land uses continued to account for the majority of the acres in this project area.

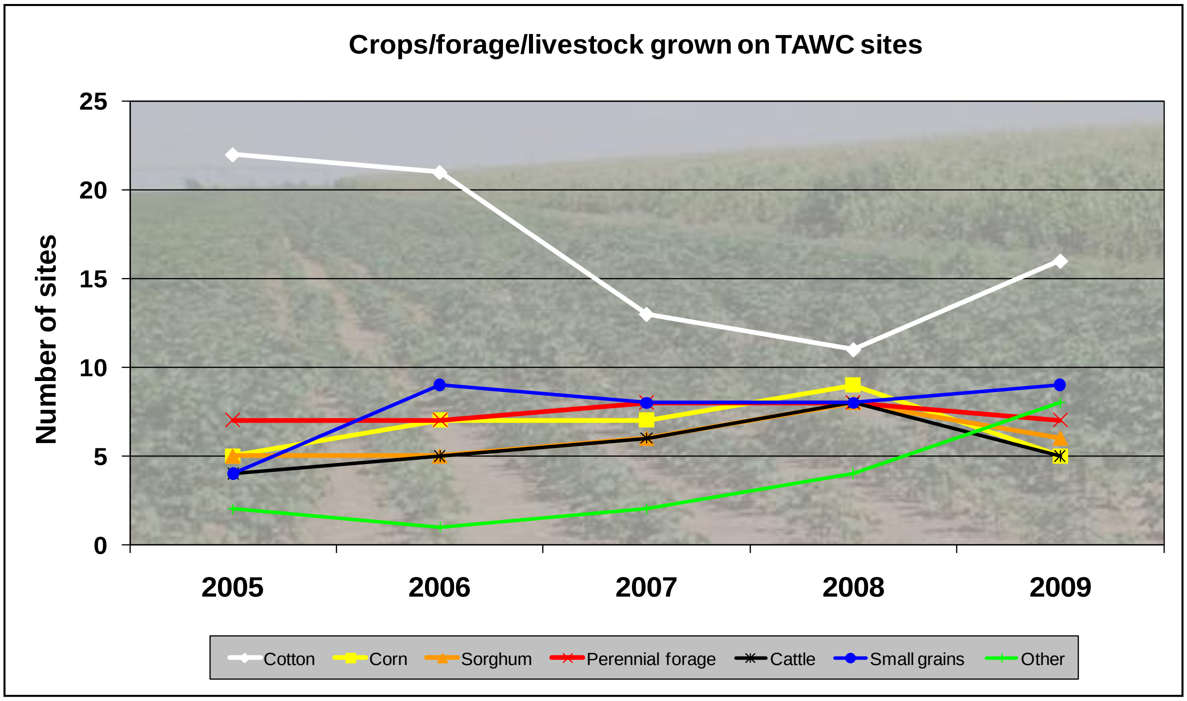


Figure 12. Number of systems (sites) that include cotton, corn, sorghum, perennial forages, cattle, small grains, and other crops within the producer systems located in Hale and Floyd Counties.

Looked at from a system basis rather than from individual crop acres, 50% of the total land in the project was devoted to multi-cropping systems in 2005 when the project began while 27% was in cotton monoculture systems (Fig 13). There were no corn or sunflower monocultures initially and 11% of the area was in integrated crop/livestock systems. Grass seed monocultures and livestock (cow-calf) only systems accounted for the remaining area. By 2009, multi-cropping system acres increased to 58% and cotton monoculture

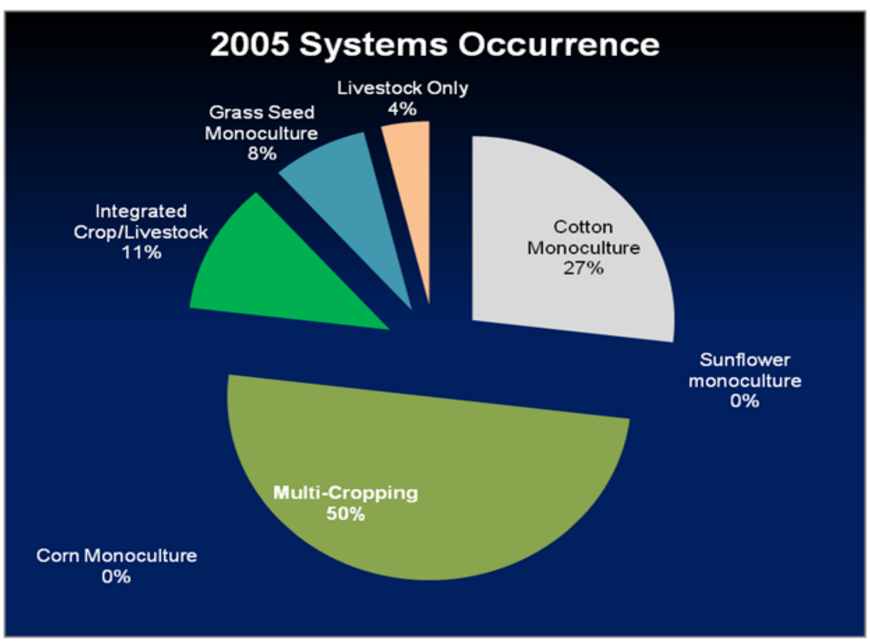


Figure 13. 2005 systems occurrence within the TAWC project sites in Hale and Floyd Counties.

acres declined to 15% (Fig. 14). Thus, the increase in total cotton acres noted above in 2009 represented additional acres in multi-cropping systems rather than expansion of cotton monocultures. Sunflower monoculture systems had appeared by 2009. While corn monoculture systems evolved in the intervening years between 2005 and 2009, they had returned to 0% of the systems in 2009. The integrated crop livestock systems had increased from 11 to 15% by 2009.

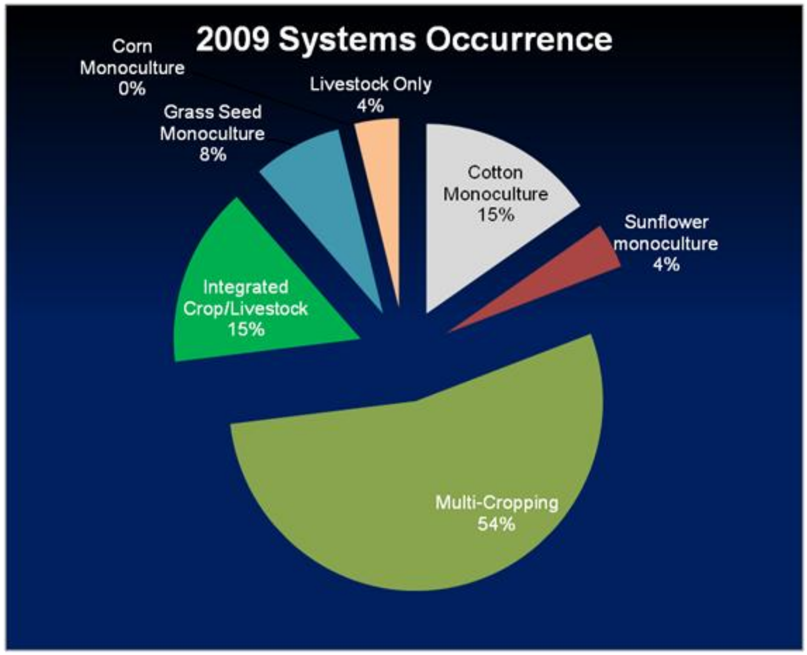


Figure 14. 2009 systems occurrence within the TAWC project sites in Hale and Floyd Counties.

Land use by producers is dynamic and reflects all of the factors that influence their decisions. Averaged over the 5 years of this project, cotton monocultures accounted for 22% of the systems, integrated crop/livestock systems were 16% of the systems and multi-cropping systems were found on 44% of the systems (Fig. 15). The mean of these 5 years shows the occurrence of the corn monocultures that had disappeared by 2009.

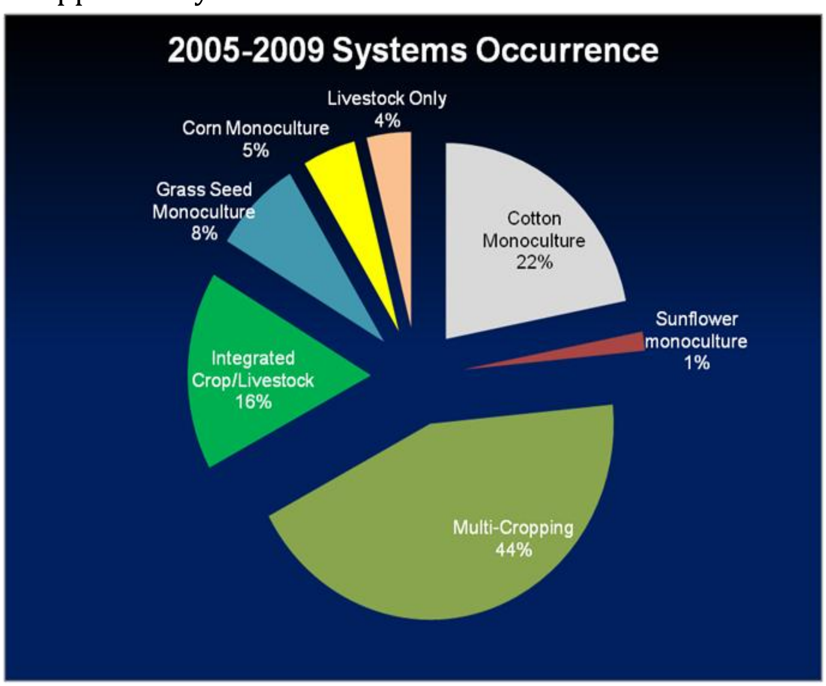


Figure 15. 2005 through 2009 systems occurrence within the TAWC project sites located in Hale and Floyd Counties.

With water scarcity an increasing reality and regulation of water use a probability in the near future, the information emerging from this demonstration is suggesting how systems can be designed and managed to remain profitable at water use levels well within anticipated regulated water use amounts. Such information is imperative to the survival of an economically viable agriculture – not only in the Texas High Plains but anywhere water is limiting.

Through the data generated from these producer managed sites, it is now possible also to identify other relationships including economic returns to specific inputs such as nitrogen fertilizer. The information collected from these sites is also allowing us to examine energy balance and the energy economics of these systems. We anticipate that with additional grant opportunities, these sites will provide valuable information on carbon balance, carbon sequestration, and other environmental impacts of these systems.

Water Use and Profitability

With 5 years of data, patterns are emerging in terms of total water use vs. profitability. This is important both because of the basic need to conserve the water resource and because of anticipated regulation of water use. In 2008, for the purposes of examining systems for meeting criteria of limited water use while maintaining profitability, we arbitrarily selected a maximum of 15 inches of irrigation water and a minimum of $300 gross margin as the desired target area for system performance. Please note that these numbers are selected only to begin this process and do not represent either the anticipated pumping limitation or the minimum amount of revenue required for agriculture to remain viable. This is simply a beginning point as we begin to understand what these limits may ultimately be and to see if a pattern in systems emerges for meeting these criteria.

In 2009, averaged over all irrigated systems, less than 11.5 inches of irrigation water was used (Fig. 9). When individual sites were examined, only 5 sites used more than this 15-inch maximum water limit even though 2009 was a relatively dry year (Fig. 16). In 2006, a year of similar precipitation, nine sites exceeded this 15-inch limit.

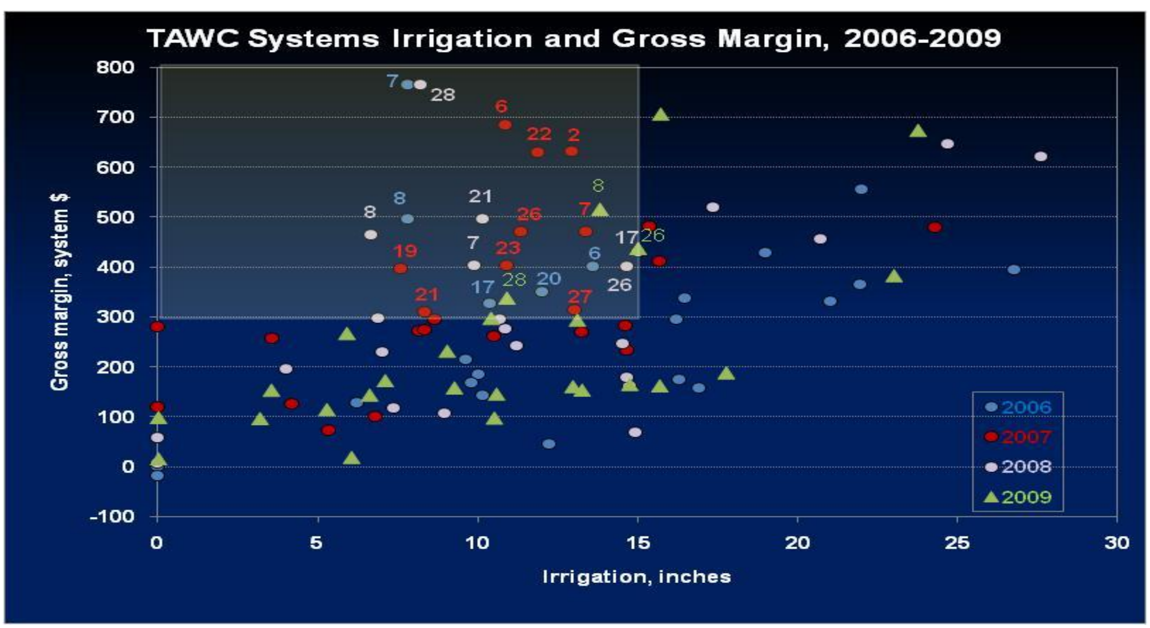


Figure 16. TAWC systems irrigation and gross margin, 2006-2009.

Only three sites in 2009 met the 15-inch water limit while generating at least $300 in gross margin. These sites included site 8 (drip irrigated sideoats grama for seed production), Site 26 (a center pivot-irrigated corn-sunflower multi-cropping system) and Site 28 (a drip-irrigated cotton monoculture). Most sites were clustered between $100 and $300 in gross margin that fell within the irrigation limit.

Reducing the minimum gross margin target to $200 and the irrigation limit to 10 inches eliminated all but 2 systems in 2009 (Fig. 17).

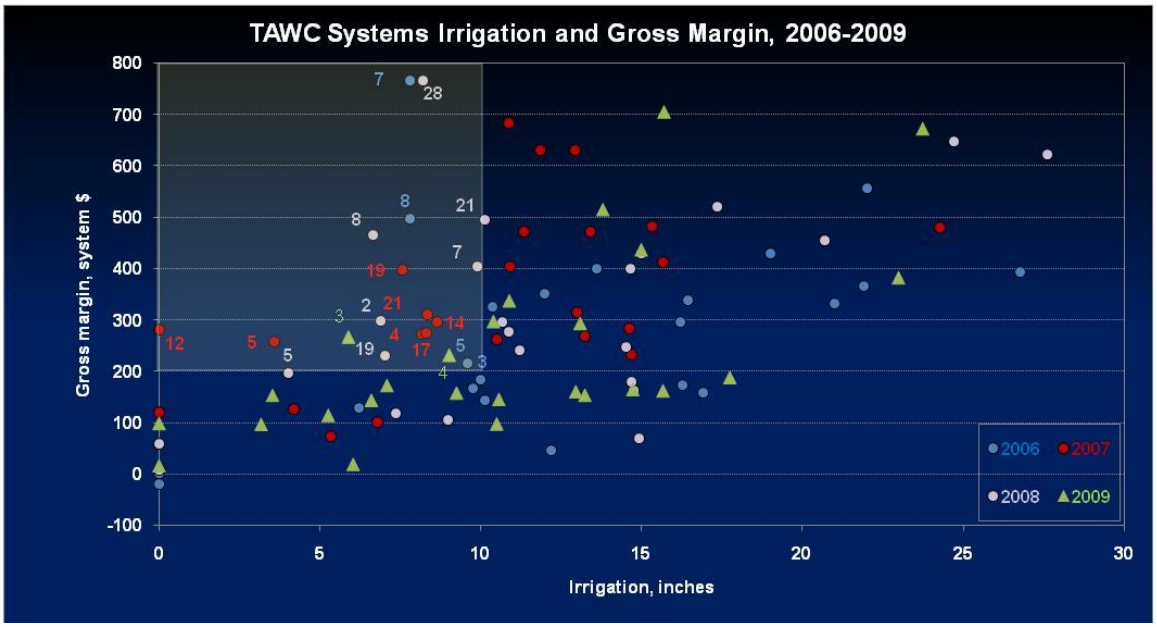


Figure 17. TAWC systems irrigation and gross margin, 2006-2009.

These systems were site 4 (a center-pivot irrigated integrated crop-livestock system that included cotton, forage and grain sorghum, alfalfa and stocker cattle) and site 3 (a center-pivot irrigated cotton and double-cropped wheat/grain sorghum multi-cropping system).

Grass seed production continued to have the highest net returns per system acre (Fig. 18) and per inch of irrigation water (Fig. 19). However, these systems also had the highest irrigation water inputs of any systems in 2009 (Fig. 19) and also received the highest inputs of nitrogen fertilizer (Fig. 20). The value of grass seed as a crop for this region strongly suggests the need for more research on optimizing water and nitrogen inputs for yield and quality of seed. If management strategies can be developed to reduce these inputs while maintaining yield and quality, grass seed offers attractive options for producers as a part of their system.

The cow-calf system (Site 5) continued to require the lowest input of nitrogen fertilizer (Fig. 20) although nitrogen applied in 2009 was above rates generally used in previous years. Irrigation water applied was lower and net returns per inch of irrigation water were higher than that of cotton as a monoculture or the integrated crop/livestock systems (Fig. 19). However, net returns were lower in 2009 than in any previous year reflecting largely the decline in prices for cattle and higher prices for nitrogen fertilizer and irrigation costs.

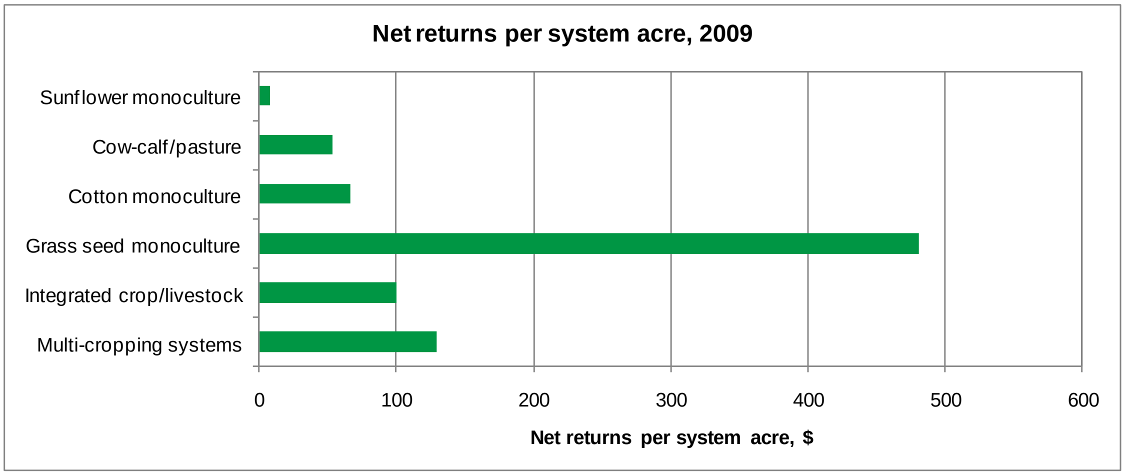


Figure 18. Net returns per system acre, 2009.

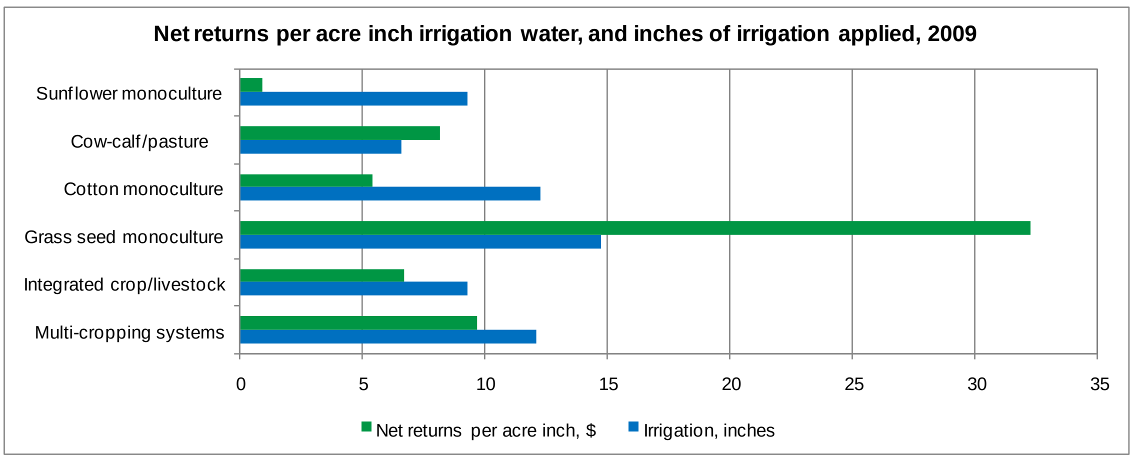


Figure 19. Net returns per acre inch irrigation water, and inches of irrigation applied, 2009.

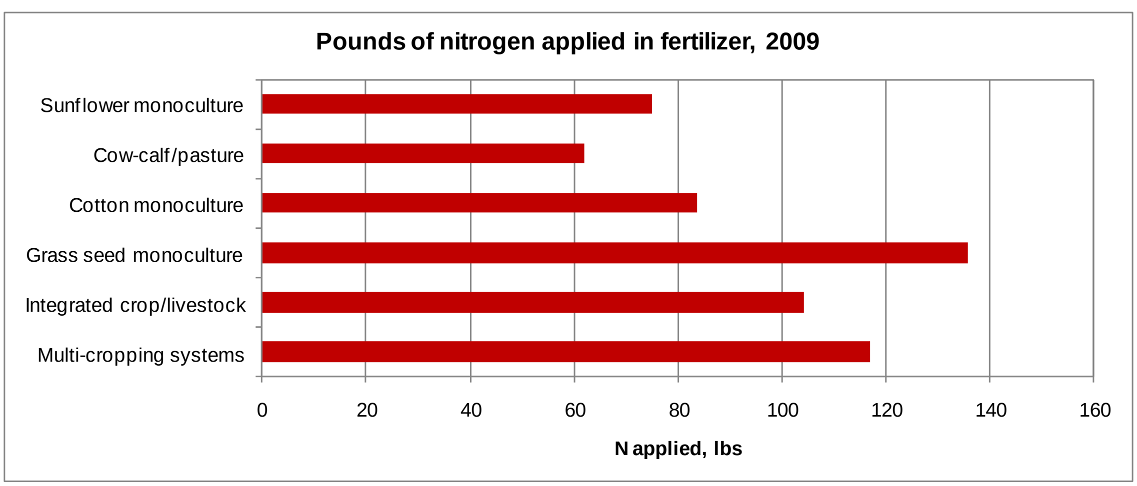


Figure 20. Pounds of nitrogen applied in fertilizer, 2009.

Irrigation water applied to the integrated crop-livestock systems was lower in 2009 than in 2008 but profitability per inch of water applied also declined. Net returns per system acre were $100 (Fig. 22), about $38/acre lower in 2009 than in 2008. The lower net returns in 2009 in the integrated crop/livestock systems likely also reflected the decline in cattle prices. Additionally, two of these systems included corn in 2008 that was replaced by sunflowers (Site 17) and cotton (Site 10) in 2009. This likely contributed to the decline in both irrigation and in profitability for these systems, compared with the previous year.

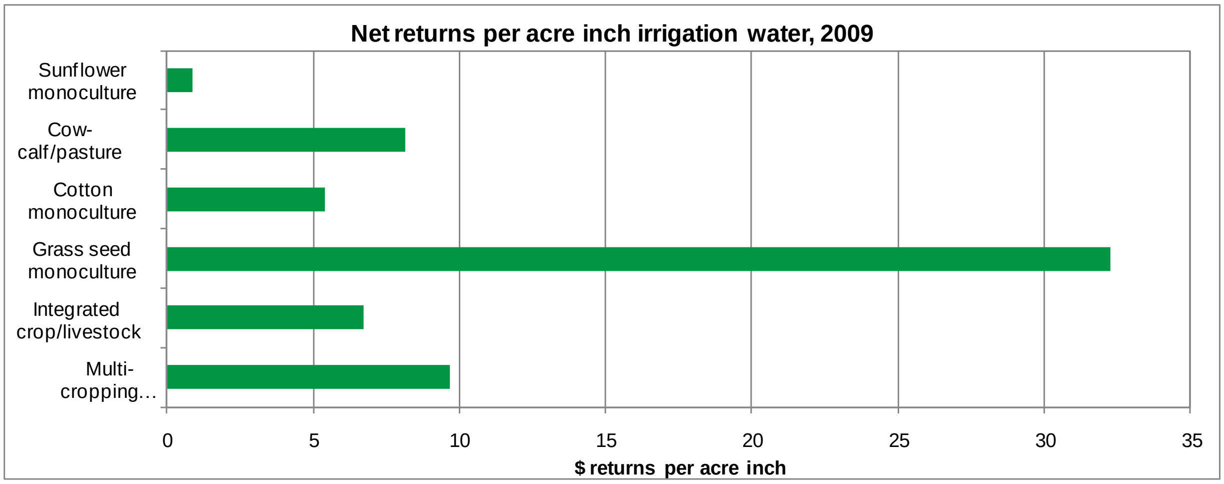


Figure 21. Net returns per acre inch irrigation water, 2009.

Irrigation water was similar between the cotton monoculture and the multi-cropping systems which also included cotton in many of these systems (Fig. 22). However, net returns per inch of irrigation water (Fig. 21) and per system acre (Fig. 18) were lower for cotton monocultures than for the mean of the multi-cropping systems.

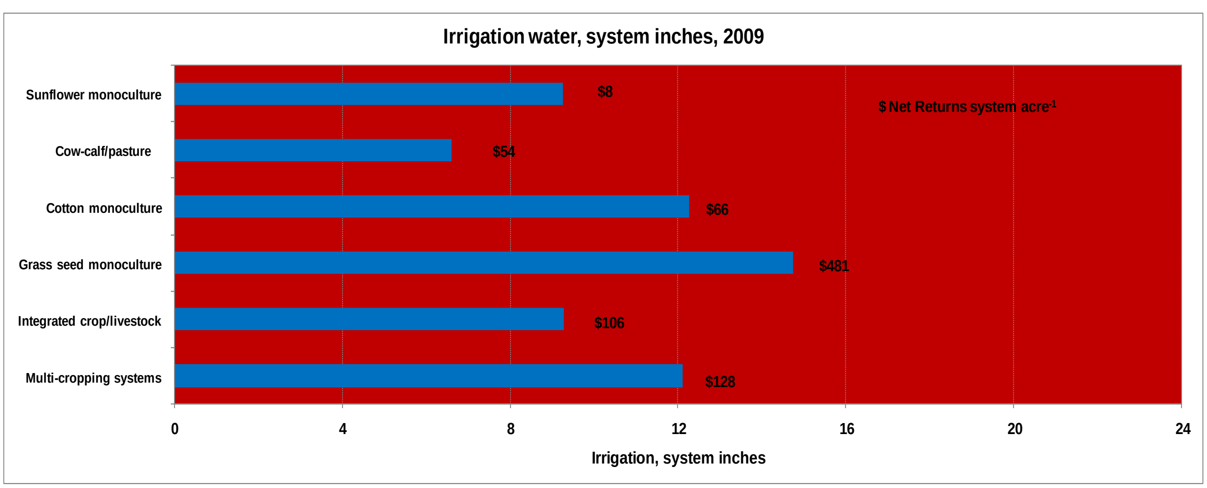


Figure 22. Irrigation water, system inches, 2009.

Multi-cropping systems were the second most profitable in net returns per system acre (Fig. 18) and per inch of irrigation water (Fig. 19) but nitrogen inputs (Fig. 20) and total irrigation water applied (Fig. 22) were high compared with most other systems. Net returns per system acre for the multi-cropping systems declined from $232 in 2008 to $131 (Fig. 22) in 2009. Nitrogen fertilizer inputs between the two years were similar and irrigation applied in 2009 was lower, averaged across the systems, than water applied in 2008. No changes in cropping system occurred on about two-thirds of these systems and changes made in remaining systems did not appear to account for this lower profitability. Thus, differences in other costs of production and prices received appeared to account for the drop in profitability.

Discussion:

What defines a sustainable level of profit for an individual or a region can vary depending on many different circumstances. Management is key to the way these systems behave. As we gain a greater understanding of the impact of the management strategies employed by these producers, it is very likely that we can make substantial progress toward water conservation and profitability.

Agriculture in the Texas High Plains has opportunities for diversity, profitability, and water conservation. There continued to be diversity among the systems that met criteria for reduced water use while meeting targets for profitability. While fewer systems achieved this target in 2009 than in previous years, the 2009 growing season was an exceptionally dry year with a cooler than normal September that further impacted crop production negatively. This was further complicated by continued low prices for cattle. Thus, most systems experienced a greater degree of challenge in this year.

By examining these systems, their component parts, factors that influenced their behavior, and decisions made by producers, we continue to gain a greater understanding of how agricultural systems in the Texas High Plains can be designed to function within a water-limited environment while generating an economic income that can provide individuals and communities with a standard of living consistent with our society. That being said, changes in government regulations beyond the control of individuals, communities, and regions, could override all of these factors and could change the future of this region and its potential to continue a viable agricultural industry.

Table 14. Summary of results from monitoring 26 producer sites during 2005 (Year 1).

System	Site No.	Acres	Irrigation Type[1]	System Inches	$/system Acre	$/inch water
Cotton	1	61	SDI	11.7	84.02	7.19
Cotton	2	68	SDI	8.9	186.94	21
Cotton	14	125	CP	6.8	120.9	17.91
Cotton	16	145	CP	7.6	123.68	16.38
Cotton	21	123	CP	6.8	122.51	18.15
Cotton	11	95	Fur	9.2	4.39	0.48
Cotton	15	98	Fur	4.6	62.65	13.62
Cotton/grain sorghum	3	125	CP	8.3	37.79	4.66
Cotton/grain sorghum	18	120	CP	5.9	16.75	2.84
Cotton/grain sorghum	25	179	DL	0	67.58	na
Cotton/forage sorghum	12	250	DL	0	36	na
Cotton/pearlmillet	19	120	CP	9.5	186.97	19.12
Cotton/corn	22	148	CP	15.3	166.63	10.9
Cotton/corn	24	129	CP	14.7	149.87	9.96
Cotton/corn	26	123	CP	10.5	192.44	18.34
Cotton/sunflowers	23	110	CP	5.4	270.62	47.07
Cotton/alfalfa	4	123	CP	5.5	110.44	19.06
Cotton/wheat	13	315	DL	0	47.37	na
Cotton/corn silage/grass	17	223	CP	10.5	188.44	17.91
Corn/wheat/sorghum silages	20	220	CP	21.5	-48.6	-2.16
Cotton/wheat/stocker cattle	6	123	CP	11.4	162.63	9.04
Cotton/grass/stocker cattle	9	237	CP	6.5	298.14	46.17
Cotton/grass/cattle	10	175	CP	8.5	187.72	22.06
Forage/beef cow-calf	5	630	CP	1.23	125.89	93.34
Forage/Grass seed	7	61	SDI	9.8	425.32	37.81
Forage/Grass seed	8	130	CP	11.3	346.9	35.56

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 15. Summary of results from monitoring 26 producer sites during 2006 (Year 2).

System	Site No.	Acres	Irrigation type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Cotton	1	135	SDI	21	225.9	10.76	15.77
Cotton	2	61	SDI	19	308.71	16.25	22.56
Cotton	27	46	SDI	18	417.99	23.22	29.89
Cotton	3	123	CP	10	105.79	10.58	18.44
Cotton	6	123	CP	13.6	321.79	23.64	29.42
Cotton	14	124	CP	6.2	44.81	7.2	19.84
Cotton	16	143	CP	12.2	71.08	5.81	8.43
Cotton	11	93	Fur	16.9	88.18	5.22	9.37
Cotton/grain sorghum	15	96	Fur	11.2	161.89	14.51	20.78
Cotton/forage sorghum	12	284	DL	0	-13.72	na	na
Cotton/forage sorghum/oats	18	122	CP	12	-32.31	-2.69	3.86
Cotton/pearlmillet	19	120	CP	9.8	95.28	9.77	17.83
Cotton/corn	22	149	CP	22	285.98	12.98	16.55
Cotton/corn	24	130	CP	19.4	68.17	3.51	8.34
Cotton/corn	26	123	CP	16	243.32	15.22	21.08
Cotton/corn	23	105	CP	14.8	127.39	8.59	13.9
Cotton/alfalfa/wheat/ forage sorghum	4	123	CP	26.7	312.33	11.69	14.75
Cotton/wheat	13	320	DL	0	-33.56	na	na
Corn/triticale/sorghum silages	20	233	CP	21.9	242.79	10.49	15.17
Cotton/stocker cattle	21	123	CP	16.4	94.94	5.79	10.22
Cotton/grass/stocker cattle	9	237	CP	10.6	63.29	6.26	13.87
Cotton/corn silage/wheat/cattle	17	221	CP	13	242.21	14.89	20.64
Forage/beef cow-calf	5	628	CP	9.6	150.46	15.62	22.31
Forage/beef cow-calf	10	174	CP	16.1	217.71	13.52	18.4
Forage/Grass seed	7	130	CP	7.8	687.36	88.69	98.83
Forage/Grass seed	8	62	SDI	10.1	376.36	48.56	64.05

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 16. Summary of results from monitoring 26 producer sites during 2007 (Year 3).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture systems							
Cotton	1	135	SDI	14.60	162.40	11.12	19.34
Cotton	2	61	SDI	12.94	511.33	39.52	48.79
Cotton	6	123	CP	10.86	605.78	55.78	63.02
Cotton	11	93	Fur	14.67	163.58	11.15	15.92
Cotton	14	124	CP	8.63	217.38	25.19	34.30
Cotton	22	149	CP	11.86	551.33	46.49	53.11
Corn	23	105	CP	10.89	325.69	29.91	37.12
Corn	24	130	CP	15.34	373.92	24.38	31.46
Corn silage	27	62	SDI	13.00	194.40	14.95	24.18
Perennial grass: seed and hay	7	130	CP	13.39	392.59	29.32	35.19
Perennial grass: seed and hay	8	62	SDI	15.67	292.63	18.67	26.33
Multi-crop systems							
Cotton/grain sorghum/wheat	3	123	CP	13.25	190.53	14.38	20.31
Cotton/grain sorghum	12	284	DL	0.00	265.71	Dryland	Dryland
Cotton/wheat	13	320	DL	0.00	105.79	Dryland	Dryland
Cotton/grain sorghum	15	96	Fur	11.30	191.68	16.96	23.15
Grain sorghum/wheat	18	122	CP	5.34	13.91	2.60	13.62
Cotton/pearlmillet	19	121	CP	7.57	318.61	42.10	52.49
Corn/sorghum/triticale silages	20	233	CP	24.27	371.14	15.29	19.76
Corn/perr. grass: seed and hay	21	123	CP	8.35	231.60	27.74	37.16
Crop-Livestock systems							
Wheat: cow-calf, grain/cotton/alfalfa hay	4	123	CP	8.18	183.72	22.47	33.30
Perennial grass: cow-calf, hay	5	628	CP	3.56	193.81	54.38	72.45
Perr. grass, rye: stocker cattle/grain sorghum	9	237	CP	4.10	48.89	11.93	30.71
Perennial grass: cow-calf, hay/corn silage	10	174	CP	6.80	27.84	4.09	14.74
Perennial grass: cow-calf, seed, hay/cotton/wheat for grazing	17	221	CP	8.31	181.48	21.83	33.06
Pearlmillet: seed, grazing/corn	26	123	CP	11.34	378.61	33.39	41.65

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 17. Summary of results from monitoring 25 producer sites during 2008 (Year 4).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture Systems							
Sunflowers	2	60.9	SDI	6.89	147.83	21.46	43.23
Perennial grass: seed and hay	7	130.0	CP	9.88	295.43	29.90	40.89
Perennial grass: seed and hay	8	61.8	SDI	6.65	314.74	47.33	69.89
Cotton	14	124.2	CP	8.97	-2.12	-0.24	11.87
Corn	22	148.7	CP	24.75	720.10	29.09	34.49
Corn	24	129.8	CP	24.70	513.54	20.79	26.20
Corn	28	51.5	SDI	8.20	591.15	72.09	93.43
Multi-crop systems							
Cotton/Wheat/Grain sorghum	3	123.3	CP	14.75	53.79	3.65	11.01
Cotton/Corn	6	122.9	CP	17.34	411.02	23.70	29.97
Cotton/Grain sorghum	11	92.5	Fur	10.86	176.14	16.22	25.43
Sorghum silage/fallow wheat	12	283.9	DL	0.00	-18.72	Dryland	Dryland
Cotton/Wheat	15	95.5	Fur/SDI				
Cotton/Wheat silage/Grain sorghum hay & silage	18	122.2	CP	10.67	186.42	17.47	27.64
Cotton/Seed millet	19	120.4	CP	7.01	121.40	17.33	32.83
Wheat grain/Grain sorghum grain & silage/hay	20	233.4	CP	27.61	513.56	18.60	22.54
Barley seed/forage sorghum hay/perr. Grass: seed & hay	21	122.7	CP	10.13	387.20	38.23	48.95
Cotton/Sunflowers	23	105.1	CP	14.93	-50.54	-3.38	4.60
Cotton/Corn grain	27	108.5	SDI	20.69	291.15	14.07	22.01
Cotton/Wheat/fallow	29	221.6	DL	0.00	33.15	Dryland	Dryland
Crop-Livestock systems							
Wheat: cow-calf, grain/cotton/alfalfa hay	4	123.1	CP	14.51	154.85	10.67	16.99
Perennial grass: cow-calf, hay	5	628	CP	5.18	95.22	18.38	35.74
Perennial Grass: stocker cattle/Cotton	9	237.8	CP	7.26	11.63	1.60	16.25
Perennial grass: cow-calf, hay/Grass seed/Corn	10	173.6	CP	14.67	-66.00	-4.50	3.34
Perennial grass: cow-calf, seed, hay/cotton/wheat for grazing	17	220.8	CP	15.00	309.34	20.62	28.68
Pearlmillet: seed, Grain sorghum/Corn: grazing, hay	26	125.2	CP	14.65	279.69	19.09	27.36

[1]SDI – Subsurface drip irrigation; CP – center pivot; Fur – furrow irrigation; DL – dryland

Table 18. Summary of results from monitoring 26 producer sites during 2009 (Year 5).

System	Site No.	Acres	Irrigation Type[1]	System inches	$/system acre	$/inch water	Gross margin per inch irrigation
Monoculture Systems							
Cotton	2	60.9	SDI	10.50	-52.29	-4.98	9.31
Perennial grass: seed and hay	7	129.9	CP	15.70	597.23	38.04	44.96
Perennial grass: seed and hay	8	61.8	SDI	13.80	365.46	26.48	37.35
Cotton	15	102.8	Fur/SDI	12.96	72.15	5.57	12.39
Cotton	22	148.7	CP	14.73	56.35	3.83	11.20
Cotton	28	51.5	SDI	10.89	187.72	17.24	31.01
Sunflower	30	21.8	SDI	9.25	8.13	0.88	17.10
Multi-crop systems							
Cotton/Grain Sorghum	3	123.3	CP	5.89	158.51	26.91	45.35
Cotton/Corn	6	122.9	CP	10.40	182.14	17.52	28.59
Cotton/Rye	9	237.8	CP	3.17	-11.71	-3.69	30.52
Cotton/Grain Sorghum	11	92.5	Fur	13.24	53.67	4.05	11.60
Sorghum silage/Wheat	12	283.9	DL	0.00	-8.81	Dryland	Dryland
Wheat grain/Cotton	14	124.2	CP	10.57	37.15	3.52	13.79
Wheat grain/Cotton	18	122.2	CP	3.53	44.88	12.71	43.47
Wheat grain/Cotton	19	120.3	CP	5.26	-4.88	-0.93	19.71
Corn silage/Cotton	20	233.3	CP	23.75	552.08	23.25	28.35
Wheat grain/Hay/perennial grass	21	122.6	CP	17.75	79.79	4.50	10.61
Oats/Wheat/Sorghum – all silage	23	105.2	CP	15.67	53.80	3.43	10.36
Corn/Sunflower	24	129.7	CP	13.09	172.53	13.18	22.42
Corn/Cotton	27	108.5	SDI	23.00	218.72	9.51	16.63
Wheat grain/Cotton	29	221.6	DL	0.00	73.79	Dryland	Dryland
Crop-Livestock systems							
Wheat/haygrazer; contract grazing, grain sorghum/cotton/alfalfa hay	4	123.1	CP	9.02	119.85	13.29	25.68
Perennial grass: cow-calf, hay	5	626.4	CP	6.60	53.76	8.15	21.79
Perennial grass: contract grazing, /Cotton	10	173.6	CP	6.04	-83.25	-13.79	4.20
Perennial grass: contract grazing, /sunflower/dahl for seed and grazing	17	220.8	CP	7.09	71.37	10.07	25.39
Corn/Sunflower, contract grazing	26	125.2	CP	14.99	316.22	21.09	29.16

Table 19. Overall summary of crop production, irrigation, and economic returns within 26 production sites in Hale and Floyd Counties during 2005, 2006, 2007 and 2008 and 2009.

Item		2005	2006	2007	2008	2009	Crop year Average
Mean Yields, per acre (only includes sites producing these crops, includes dryland)							
Cotton							
	Lint, lbs	1,117 (22) [1]	1,379 (20)	1,518 (13)	1,265 (11)	1,223 (16)	1,300.40
	Seed, tons	0.80 (22)	0.95 (20)	1.02 (13)	0.86 (11)	0.81 (16)	0.89
Corn							
	Grain, lbs	12,729 (3)	8,814 (4)	12,229 (4)	10,829 (8)	12,613 (4)	11,442.80
	Silage, tons	30.9 (2)	28.3 (3)	27.3 (3)	-	38.3 (1)	31.20
Sorghum							
	Grain, lbs	4,147 (3)	2,987 (1)	6,459 (4)	6,345 (5)	6,907 (3)	5,369.00
	Silage, tons	26.0 (1)	20.4 (2)	25.0 (1)	11.3 (2)	9.975 (2)	18.54
	Seed, lbs				3507 (1)		3,507.00
Wheat							
	Grain, lbs	2,034 (1)	-	2,613 (5)	4,182 (5)	2,061 (6)	2,722.50
	Silage, tons	16.1 (1)	7.0 (1)	-	7.5 (1)	3.71 (1)	8.58
	Hay, tons	-	-	-	-	2.5 (1)	2.50
Oat							
	Silage, tons	-	4.9 (1)	-	-	12.5 (1)	8.70
	Hay, tons	-	1.8 (1)	-	-		1.80
Barley							
	Grain, lbs	-	-	-	3,133 (1)		3,133.00
	Hay, tons	-	-	-	5.5 (1)		5.50
Triticale							
	Silage, tons	-	21.3 (1)	17.5 (1)	-		19.40
Sunflower							
	Seed, lbs	-	-	-	1,916 (2)	2,274 (4)	2,095.00
Pearl millet for seed							
	Seed, lbs	3,876 (1)	2,488 (1)	4,002 (2)	2,097 (2)		3,115.75
Perennial grass							
Dahl							
	Seed, PLS lbs	-	-	-	30 (1)	83.14 (1)	56.57
	Hay, tons	-	-	-	2.5 (1)		2.50
SideOats							
	Seed, PLS lbs	313 (2)	268 (2)	96 (5)	192.9 (4)	362 (3)	246.38
	Hay, tons	-	-	-	1.66 (3)	1.83 (3)	1.75
Other							
	Hay, tons	-	-	-	0.11 (1)	4.3 (1)	2.21
Alfalfa							
	Hay, tons	8.3 (1)	9.18 (1)	4.90 (1)	12.0 (1)	9.95 (1)	8.87
Precipitation, inches (including all sites)		15.0	15.4	27.3	21.7	15.1	18.89
Irrigation applied, inches (not including dryland)							
By System							
Total irrigation water (system average)		9.2 (26)	14.8 (26)	11.0 (25)	13.3 (23)	11.31 (25)	12.10
By Crop (Primary Crop)							
Cotton		8.7 (19)	14.3 (19)	11.3 (11)	12.2 (10)	12.5 (15)	11.80
Corn grain		17.4 (3)	21.0 (4)	12.5 (4)	21.7 (8)	19.2 (4)	18.36
Corn silage		18.0 (2)	24.0 (3)	12.6 (3)	-	24.3 (1)	19.73
Sorghum grain		7.5 (1)	4.2(1)	6.6 (4)	12.3 (5)	9.4 (3)	8.00
Sorghum silage		15.0 (1)	12.5 (2)	13.5 (1)	11.5 (1)	15.7 (1)	13.64
Wheat grain		-	-	5.3 (3)	7.68 (4)	5.7 (5)	6.23
Wheat silage		7.5 (1)	16.3 (1)	-	5.5 (1)	15.7 (1)	11.25
Oat silage		-	4.3 (1)	-	-	15.7 (1)	10.00
Oat hay		-	4.9 (1)	-	-	-	4.90
Triticale silage		-	10.0 (1)	12.9 (1)	-	-	11.45
Barley grain		-	-	-	12.8 (1)	-	12.80
Small Grain (grazing)		0.5 (3)	0.8 (2)	0.8 (3)	-	-	0.70
Small Grain (grains)		-	-	5.3 (3)	8.7 (5)	-	7.00
Small Grain (silage)		7.5 (1)	10.2 (3)	12.9 (1)	5.5 (1)	-	9.03
Small Grain (hay)		-	4.9 (1)	-	-	-	4.90
Small Grain (all uses)		5.2 (5)	7.3 (10)	7.44(11)	8.2 (6)	-	7.04
Sunflower seed		-	-	-	9.6 (2)	8.9 (4)	9.25
Millet seed		-	-	-	9.6 (2)	-	9.60
Dahl							
hay		-	-	-	4.65 (1)	-	4.65
seed					9.4 (1)	8.9 (1)	9.15
grazing						4.1 (1)	4.10
Sideoats							
seed		-	-	-	8.0 (3)	15.3 (3)	11.65
Bermuda							
grazing		-	-	-	6.2 (1)	5.3 (1)	5.75
Other Perennials							
hay		-	-	-	4.02 (1)		4.02
grazing					5.5 (1)	6.6 (1)	6.05
Perennial grasses (grouped)							
Seed		-	-	-	8.35 (4)	13.7 (4)	11.03
Grazing		-	-	-	5.85 (2)	5.3 (3)	5.58
Hay		-	-	-	4.33(2)	-	4.33
All Uses		6.5 (6)	8.8 (6)	7.1 (7)	6.7 (8)	10.1 (7)	7.84
Alfalfa		10.3 (1)	34.5 (1)	10.6 (1)	15.6 (1)	18.6 (1)	17.92
Income and Expense, $/system acre							
Projected returns		660.53	773.82	840.02	890.37	745.82	782.11
Costs							
	Total variable costs (all sites)	444.88	504.91	498.48	548.53	507.69	500.90
	Total fixed costs (all sites)	77.57	81.81	81.77	111.98	110.65	88.28
	Total all costs (all sites)	522.45	586.72	580.25	660.51	618.34	593.65
Gross margin							
	Per system acre (all sites)	215.66	268.91	341.54	341.84	238.13	281.21
	Per acre inch irrigation water (irrigated only)	33.50	22.53	34.01	31.17	22.96	28.83
Net returns over all costs							
	Per system acre (all sites)	138.09	187.10	259.77	229.86	127.48	188.46
	Per acre inch of irrigation water (irrigated only)	21.57	15.88	24.98	20.89	9.99	20.83
	Per pound of nitrogen (all sites)	1.62	0.81	2.34	1.48	0.87	1.42

[1] Numbers in parenthesis refer to the number of sites in the mean.

REPORTS BY SPECIFIC TASK

TASK 2: PROJECT ADMINISTRATION

2.1 Project Director: Rick Kellison.

The 2009 growing season is among a long list of unique years in the Texas Panhandle. Our winter of 2008 and 2009 was extremely dry with very little no winter wheat grazing. This lack of rainfall had an adverse effect on the establishment of all dry land crops. Again, we were very fortunate in that we had very limited hail damage in the TAWC project area. Our irrigated crops yielded extremely well. What rainfall we did receive during the growing season was very timely and obviously had a positive effect on yields. September was much cooler than normal but we were still able to harvest a quality cotton crop.

We focused a lot of time and effort in testing and later in development of the TAWC irrigation scheduling and the resource management tools. We are in the process of making these tools available for producers in the 2010 growing season. Another irrigation scheduling tool that we are continuing to gather information on is the SmartCrop sensors. It is my understanding that NRCS will cost share the purchase of this equipment by the producers. Thus, we see the need to better understand how to use this technology.
I have had two meetings with Senator Robert Duncan and Sarah Clifton during 2009. On August 10th Dr. Allen and I met with Senator Duncan to deliver the annual report and discuss the demonstration project. Senator Duncan suggested that we consider an implementation phase of the project. The second meeting on October 19th focused on additional information on various grant proposals that TAWC might be suited for. We also continued the discussion of the addition of new sites to TAWC. These sites would move into the implementation phase where TAWC would be more involved in the management of irrigation applied.

We had several meetings with the management team to develop our presentation for the NRCS / Congressional visit and tour. The presentation was held on August 17th at the High Plains Underground Water District office and the TAWC tour on August 18th. We had sixty guests attend the tour. On February 3rd, we held the TAWC field day. There were ninety – three people in attendance, most of which were producers. These producers came from as far away as Tahoka and Canyon which represents more than an eighty mile radius from the TAWC demonstration area. Dr. David Doerfert was very instrumental in the success of the field day. We were able to assemble a group of speakers who covered a wide range of important and timely topics.

On January 25, 2010, I helped Dr. Allen and others host a tour for Dr. Lynn Sollenberger, a visiting scientist from the University of Florida. Dr. Sollenberger is a possible hire for the Plant and Soil Science Department. On January 26, 2010, Dr. Sollenberger met with the TAWC management team and members of the advisory committee. At this meeting questions were asked and ideas exchanged about the mechanics of the TAWC demonstration project.

Producer Board Meetings for 2009:

December 10, 2009

Presentations for 2009:

01-21-09	Caprock Crop Conference
04-15-09	Texas Tech Forage Class
04-21-09	Board of Directors, High Plains Underground Water District
08-17-09	NRCS/Congressional visit
08-27-09	Panhandle Association of Soil and Water District
10-09-09	Visiting producers from Colombia
10-13-09	Briscoe County Field Day
01-13-10	Floydada Rotary Club
02-03-10	TAWC Field Day

Tours for 2009:

07-07-09	National Sorghum Producers
09-14-09	AgriLIFE Extension personnel
12-15-09	Dr. Steven Maas, Dr. Wayne Hudnall

We have held twelve management team meetings this year. I have made frequent site visits throughout this past year.

2.2 Secretary/Bookkeeper: Angela Beikmann. *(three-quarter time position).* Year 5 main objectives for the secretarial and bookkeeping support role for the TAWC project include the following.

Accurate Accounting of All Expenses for the Project. This includes monthly reconciliation of accounts with TTU accounting system, quarterly reconciliation of subcontractors' invoices, preparation of itemized quarterly reimbursement requests, and preparation of Task and Expense Budget and Cost Sharing reported for Year 5 of the project. A formal TAWC budget amendment request for years 6-8 of the project was proposed to the Texas Water Development Board in November 2009. This budget amendment did not affect the total award amount ($6,224,775) or any of the subcontractors' total award amounts. It did slightly alter Task 1, 2 and 9 budgets and significantly modified all expense category budgets except for subcontracts and overhead. Cost share amounts were also unaffected.

Administrative Support for Special Events. Presentation, meeting and site tour was held on August 17-18. Pre-event planning and preparations were made, including travel arrangements, bus and facility rentals and various correspondence. Attended the August 18 event in Muncy, Texas to assist with arrangements and presentations as requested.

Ongoing Administrative Support. Year 4 Annual Report was completed and presented to Texas Water Development Board, Senator Robert Duncan, TAWC participants and producers in June 2009.

TAWC producer binders were assembled for each TAWC producer to categorize their records. These binders greatly assist the research team in acquiring useful data for this annual report and other communications.

Per the request of the TAWC Project Director, irrigation scheduling reports were compiled and forwarded to the project director for distribution to the TAWC producers.

Quarterly reports have been assembled and forwarded to TWDB. These quarterly reports, dated May 31, 2009, August 31, 2009, November 30, 2009 and February 28, 2010, coincide with quarterly reimbursement requests submitted by TTU.

Management Team meeting minutes have been recorded and transcribed for each meeting. These meetings were held on March 13, April 10, May 8, June 12, August 14, September 11, October 16, November 20, December 11, 2008, and January 15 and February 12, 2009.

Considerable time has been spent this year on attending meetings, workshops, forums and training classes regarding the new TTU web-based financial and informational system. Attendance at these types of events will continue as this new system continues to be upgraded and improved, and campus policies and/or procedures continue to be revised.

Daily administrative tasks include many clerical procedures and documents pertaining to a business/education setting.

TASK 3: FARM ASSISTANCE PROGRAM

Dr. Steven Klose
Jeff Pate
Jay Yates

Year 5 project progress regarding task 3 in the overall project scope of work has occurred in several areas ranging from collaborating in project coordination and data organization to data collection and communication, as well as, providing additional services to the area producers in conjunction with the TAWC project. A brief summary of specific activities and results follows:

Project Collaboration. A primary activity of initiating the FARM Assistance task included collaborating with the entire project management team and coordinating the FARM Assistance analysis process into the overall project concepts, goals, and objectives. The assessment and communication of individual producer's financial viability remains crucial to the evaluation and demonstration of water conserving practices. Through AgriLife Extension participation in management team meetings and other planning sessions, collaboration activities include early development of project plans, conceptualizing data organization and needs, and contributions to promotional activities and materials.

Farm Field Records. AgriLife Extension has taken the lead in the area of data retrieval in that FARM Assistance staff is meeting with producers three times per year to obtain field records and entering those records into the database. AgriLife Extension assisted many of the project participants individually with the completion of their individual site demonstration records (farm field records). Extension faculty have completed the collection, organization, and sharing of site records for most of the 2009 site demonstrations.

FARM Assistance Strategic Analysis Service. FARM Assistance service is continuing to be made available to the project producers. The complete farm analysis requires little extra time from the participant, and the confidentiality of personal data is protected. Extension faculty have completed whole farm strategic analysis for several producers, and continue to seek other participants committed to the analysis. Ongoing phone contacts, e-mails, and personal visits with project participants promote this additional service to participants.

In addition to individual analysis, FARM Assistance staff has developed a model farm operation that depicts much of the production in the demonstration area. While confidentiality will limit some of the analysis results to averages across demonstrations, the model farm can be used to more explicitly illustrate financial impacts of water conservation practices on a viable whole farm or family operation.

FARM Assistance Site Analysis. While the whole farm analysis offered to demonstrators as a service is helpful to both the individual as well as the long-term capacities of the project, the essential analysis of the financial performance of the individual sites continues. FARM Assistance faculty completed and submitted economic projections and analysis of each site based on 2008 demonstration data. These projections will serve as a baseline to for future site and whole farm strategic analysis, as well as providing a demonstration of each site's financial feasibility and profitability. Each producer in the project received a copy of the analysis for their site based on the 2008 data. This analysis can be used by each producer to establish some economic goals for the future. 2009 analysis will be completed this summer, as yield data has only recently been finalized for the 2009 crop.

Economic Study Paper. Farm Assistance members completed a study paper utilizing the economic data on all sites within the TAWC project. The paper compared the economic impact of dryland crops verses crops grown under irrigation. The study closely examines the financial impact that would occur when irrigated land has been converted to dryland within the region. The results of this paper were presented at the Beltwide Cotton Conference held in New Orleans this past January.

Continuing Cooperation. Farm Assistance members also continue to cooperate with the Texas Tech Agriculture Economics Department by furnishing data and consulting in the creation of annual budgets. These budgets will later be used by Farm Assistance members to conduct site analysis for each farm in the TAWC project.

TASK 4: ECONOMIC ANALYSIS

Dr. Phillip Johnson
Dr. Eduardo Segarra
Dr. Justin Weinheimer
Cody Zilverberg

Objective. The economic assessment will evolve over time with the integration of the demonstration project; allowing baseline data to be developed for both economic and agronomic analysis. As joint effort between the Texas Agri-Life, Texas A&M University and the Texas Tech University Department of Agricultural and Applied Economics (AAEC) will develop and maintain detailed records of inputs and production (costs and returns) on each farm production scenario using enterprise budgets developed from producer field records and the Texas AgriLife's FARM Assistance program. These records will provide the base data for determining the economic impact of observed technologies for producers and water utilization.

Achievements

- 2009 represented the fifth year of economic data collection from the project sites. Data for the 2009 production year has been compiled and enterprise budgets have been generated.

- In correlation with the Task objectives, data analysis is an ongoing goal throughout the production year. As summarized in the Demonstration Project Profitability Evaluation 2005-2008, the economics of various crop production systems were compiled to understand how certain agronomic systems consistently remain profitable while utilizing water resources to maximize agronomic and financial potential. This annual economic summary, 2005 – 2008, was presented at the annual field day on February 3, 2010.

- An economic decision tool for agricultural producers was developed under "TAWC Solution: Decision Aids for Irrigation, Economics, and Conservation" to provide an economic planning aid for regional irrigated farmers. This unique economic decision tool uses producer input to provide field level crop allocation options which maximize net returns per acre under limiting irrigation conditions. Variables such as water available for irrigation, production cost, expected commodity prices, and acreage plans are entered by each producer providing a unique output which matches their individual management and production capabilities. This tool is currently in its final stages of development and should be released via a web based interface by spring 2010.

- Task 4 has also been utilizing the field level data from project sites to evaluate carbon emissions and energy consumption within irrigated agriculture. While all row-crop systems within the project have been audited for carbon and energy, cotton specific sites were compiled and presented at the 2010 Beltwide Cotton

Conference. “Energy and Carbon: Considerations for High Plains Cotton” interacted not only carbon and energy estimates for High Plains Cotton production but also considered the field level profitability and irrigation efficiency of each observation and irrigation technology observed. Results indicate that cotton grown under Low Energy Precision Application (LEPA) irrigation systems could be the most profitable while maximizing irrigation efficiency. Additionally these systems proved to be the most energy efficient thus emitting the lowest amount of carbon per acre.

Presentations and paper proceedings related to the TAWC in 2009:

- Weinheimer J., and P. Johnson, 2009. Energy and Carbon. Considerations for High Plains Cotton. Beltwide Cotton Conference, New Orleans LA, January 2010

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

- Weinheimer J., and P. Johnson, 2009. Irrigated Agriculture. United Farm Industries, Board of Directors, Lubbock Texas, December 2009.

- Weinheimer J. Water Allocation Tool. Texas Alliance for Water Conservation, Producer Board Meeting, Lockney Texas, December 2009.

- Weinheimer J., and P. Johnson, 2009. Economics and Energy. High Plains Underground Water District, Texas Alliance for Water Conservation Outreach Meeting, Lubbock Texas, August 2009.

- Weinheimer J., and P. Johnson, 2009. Water Policy in the Southern High Plains: A Farm Level Analysis. Universities Council on Water Resources, Chicago Illinois, July 2009.

- Weinheimer J., and P. Johnson, 2009. Economics of State Level Water Conservation Goals. Western Agricultural Economics Association Annual Meetings, Kauai Hawaii, June 2009.

- Weinheimer J., and P. Johnson. 2009. Water Policy Impacts on High Plains Cropping Patterns and Representative Farm Performance. Cotton Economics Research Institutes 9th Annual Symposium (CERI), Lubbock Texas, April 2009.

Demonstration Project Profitability Evaluation 2005-2008

Two primary resources should be utilized efficiently, land and irrigation water. This evaluation identified the sites and systems within the TAWC project which have *consistently* produced the highest returns per acre while utilizing irrigation water efficiently. The economic comparison is based on Gross Margin (gross revenue less direct costs) and provides two separate yet linked values:

1. Gross margin per acre of land (GM/Ac).
2. Gross margin per acre inch of irrigation water applied. (GM/Ac In)

Data for the sites in the TAWC project were averaged for the years 2005, 2006, 2007 and 2008; and ranked for gross margin per acre and gross margin per acre inch of irrigation. The sites shown in Tables 20, 21 and 22 are ranked by GM/Ac In and were in the "Top 10" for each criterion, GM/Ac and GM/Ac In. Of the Top Performing Systems shown in Table 20, one was livestock, two were grass seed monoculture, and four were multi-crop. Irrigation water applied ranged from 7.6 to 18.49 inches.

Table 20. Top performing systems 2005 - 2008.

Rank	Irrigation Applied	Gross Margin Per Acre[1]	Gross Margin Per Acre Inch[1]	Irrigation Technology[2]	Crop or Rotation[3]			
	Acre Inches	$/Acre	$/Acre Inch		2005	2006	2007	2008
1	7.6	362.60	70.65	MESA	GR/CC	GR/CC	GR/CC	GR/CC
2	10.22	536.27	56.42	LESA	GS	GS	GS	GS
3	10.36	460.91	50.35	SDI	GS	GS	GS	GS
4	11.92	416.21	37.31	SDI	CT	CT	CT	SF
5	13.31	446.24	34.51	LESA	CT	CT	CT	CT/CR
6	10.43	291.02	31.12	LEPA	CT	CT/CR	CR/GS	GS/FS
7	18.49	523.44	30.01	LEPA	CT/CR	CT/CR	CT	CR

Table 21. Top performing cropping systems, 2005 - 2008.

Rank	Irrigation Applied	Gross Margin Per Acre[1]	Gross Margin Per Acre Inch[1]	Irrigation Technology[2]	Crop or Rotation[3]			
	Acre Inches	$/Acre	$/Acre Inch		2005	2006	2007	2008
1	10.22	536.27	56.42	LESA	GS	GS	GS	GS
2	10.36	460.91	50.35	SDI	GS	GS	GS	GS
3	11.92	416.21	37.31	SDI	CT	CT	CT	SF
4	13.31	446.24	34.51	LESA	CT	CT	CT	CT/CR
5	10.43	291.02	31.12	LEPA	CT	CT/CR	CR/GS	GS/FS
6	18.49	523.44	30.01	LEPA	CT/CR	CT/CR	CT	CR
7	13.11	376.53	29.59	LEPA	CT/CR	CT	CR/ML	CR/Ml/SR

Table 22. Top performing livestock and integrated crop/livestock systems, 2005 - 2008.

Rank	Irrigation Applied	Gross Margin Per Acre[1]	Gross Margin Per Acre Inch[1]	Irrigation Technology[2]	Crop or Rotation[3]			
	Acre Inches	$/Acre	$/Acre Inch		2005	2006	2007	2008
1	7.6	362.60	70.65	MESA	GR/CC	GR/CC	GR/CC	GR/CC
2	6.99	190.66	29.72	MESA	GR/SC/CT	GR/SC/CT	GR/SC/CT	GR/SC/CT
3	12.52	326.64	27.00	MESA	GR/CR/CT	GR/CC/CR/CT	GR/CC/CT	GR/CC/GS/CT/WH
4	11.54	180.10	17.18	LESA	GR/CC/CT	GR/CC/FR	GR/CC/CR	GR/CC/GS/CR

[1]Gross Margin (GM) represents Gross Revenues less Direct Costs
[2]Abbreviation: LESA – Low Evaluation Spray Application
LEPA – Low Energy Precision Application
MESA – Mid Evaluation Spray Application
SDI – Subsurface Drip System
[3]Abbreviation: CC – Cow/Calf; CT – Cotton; CR – Corn
FS – Forage Sorghum; GR – Grass; GS – Grass Seed
ML – Millett Seed; SC – Stocker Cattle; SF – Sunflowers
WH – Wheat

Figure 23 shows the GM/Ac and the Ac In of irrigation applied for 25 sites that consist of grass seed monoculture, cotton monoculture, multi-crop, livestock and integrated crop/livestock, and dryland systems. Systems located in the area identified in the upper left corner of the figure represent those systems that had GM/Ac above $300 and irrigation applied less than 15 inches per acre. The Top Performing Systems are identified, with 5 of the 7 falling within the highlighted area. One of the objectives of the TAWC is to identify systems that increase or maintain profitability while utilizing irrigation efficiently. To sustain irrigated agriculture in the Texas High Plains, ideally producers would select systems that move towards the upper left corner of Figure 23 to maximize profitability and water use efficiency.

Figure 24 presents the average GM/Ac and irrigation applied for each system over the four years of the project. It should be noted that all irrigated systems had average water applied below 14 acre inches and average gross margin above $200 per acre. The average gross margin for the dryland system was $70 per acre.

The results indicate that there are a variety of enterprise and system options producers can choose to address profitability and conservation goals.

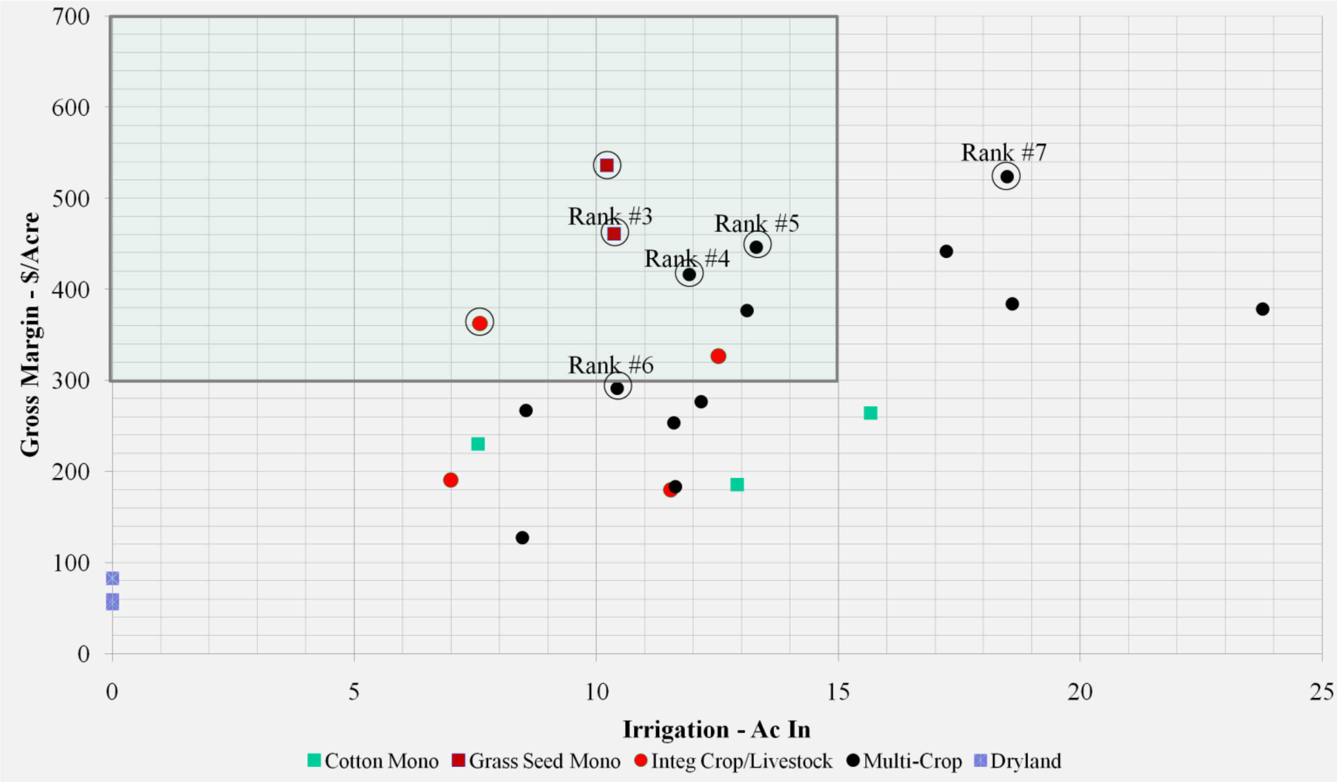


Figure 23. System gross margin, 2005 - 2008.

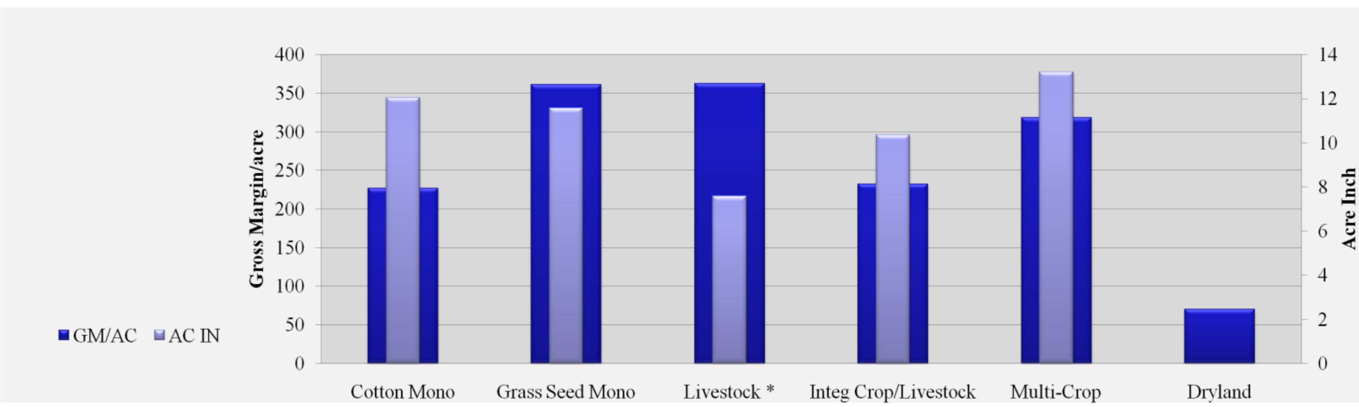


Figure 24. Gross margin and irrigation by system, 2005 - 2008.

Average gross margin and irrigation applied for all irrigation technologies across all years.
* Livestock is represented by only one (1) site across all years.

TASK 5: PLANT WATER USE AND WATER USE EFFICIENCY

Dr. Stephan Maas
Dr. Nithya Rajan

The objective of this task is to estimate the actual amount of water used by crop, grassland, and pasture vegetation in the growth process. This quantity is called the daily crop water use (CWU), and can be accumulated over the growing season to estimate the total water used in growing a crop, grassland, or pasture. CWU does not include water lost from the field through soil evaporation, runoff, or deep percolation. CWU can be compared to the water applied to the field, either through irrigation and/or precipitation, to estimate the efficiency of water application in producing a crop.

Table 23 lists the satellite data acquisition dates for 2009. As in the previous year, sky conditions allowed the acquisition of Landsat images at frequent intervals over the summer growing season. Few image acquisitions were lost due to cloud cover.

Table 23. Acquisition dates in 2009 for Landsat-5 Thematic Mapper (TM) and Landsat-7 Enhanced Thematic Mapper + (ETM+) imagery.

Landsat-5 TM	Landsat-7 ETM+
June 6	May 13
June 22	May 29
July 8	August 17
July 24	September 2
August 9	November 5
August 25	
September 26	

Airborne multispectral imagery was also acquired in 2009 using TTAMRSS (the Texas Tech Airborne Multispectral Remote Sensing System). This system was flown aboard a Cessna Model 172 Skyhawk aircraft in cooperation with South Plains Precision Ag. TTAMRSS imaging flights are summarized in Table 24.

Table 24. Acquisition dates for TTAMRSS in 2009.

Date
June 16
July 10
August 25

These airborne acquisitions were scheduled to coincide with an extensive program of ground measurements aimed at studying the relationships between remotely sensed image data and crop ground cover (GC), leaf area index (LAI), and above-ground biomass (AGDM). The fields and crops that were sampled in association with the various TTAMRSS acquisitions are presented in Table 25. Analysis of these data is ongoing.

Table 25. Fields sampled in 2009 for GC, LAI and AGDM.

16 June	10 July	25 August
Field 20 corn	Field 02 cotton	Field 02 cotton
Field 24 corn	Field 04 cotton	Field 04 cotton
Field 26 corn	Field 04 corn	Field 11 sorghum
Field 24 sunflower	Field 04 sorghum	Field 11 cotton
Field 26 sunflower	Field 11 sorghum	Field 22 cotton
Field 22 cotton	Field 11 cotton	Field 23 sorghum
	Field 18 cotton	Field 21 grass
	Field 22 cotton	
	Field 23 sorghum	
	Field 24 corn	
	Field 24 sunflower	
	Field 20 corn	
	Field 27 cotton	

One of our eddy covariance (EC) systems was located at Field 11 during the period March 22 to April 23 (day 81-113) prior to planting. The objective was to collect data on bare soil evaporation and its relationship to remotely sensed soil brightness. In addition to the EC system, a set of miniature radiometers were used to continuously measure soil reflectance in the red and near-infrared (NIR) spectral wavelengths. Also included at the site were sensors to measure soil moisture and the components of the surface energy balance. Measured values of soil reflectance and soil moisture (measured at 4 cm below the surface) during this period are shown in Figure 25. During the first part of the study, the soil was dry and had relatively high reflectance in both the red and NIR wavelengths. Two substantial rains occurred on days 101 and 106. These resulted in an increase in soil moisture and reduced reflectance from the soil surface. As the soil dried after these events, the reflectance increased. As shown in Figure 26, the latent heat flux due to evaporation from the soil increased markedly after the rains. Using the Penman-Monteith Equation and the surface energy balance data, we calculated the corresponding values of the surface resistance to water evaporation from the soil surface. Using the soil reflectance data, we calculated values of a Soil Brightness Index (SBI) that ranged from 0 (for dry, bright soil) to 100 (for dark, wet soil). Combining these results, we were able to relate soil surface resistance to SBI (Figure 27). As the figure indicates, the resistance to soil evaporation is low for SBI values greater than 40. However, once SBI values fall below 20, the soil surface is dry and the resistance to evaporation is greatly increased. These results are potentially useful in estimating soil evaporation using remote sensing.

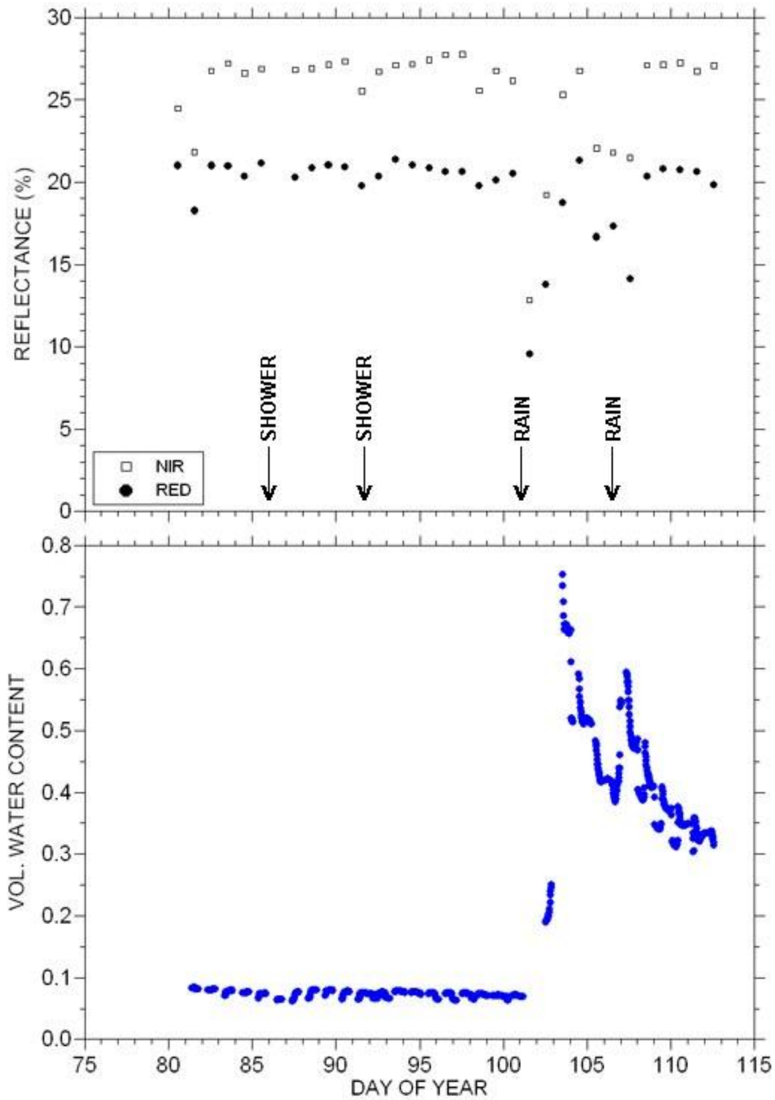


Figure 25. Soil reflectance and soil moisture measured in Field 11 in 2009 prior to planting.

EC systems were located at Field 22 (corn) and 02 (cotton) for extended periods during the 2009 growing season. The objective was to obtain a detailed, continuous set of measurements of crop evaporation extending over most of the life of the crops. The EC systems were supplemented by sensors to measure all aspects of the crop microenvironment, including components of the surface energy balance, soil moisture and temperature profiles, plant canopy and soil surface temperature, rainfall, and soil reflectance. In addition to continuous measurements of crop evaporation, microlysimeters were installed and measured on a number of dates to quantify soil evaporation. Overhead photographs of the crop canopies were made periodically to determine crop ground cover (GC), and destructive samples were taken to the lab to determine leaf area index (LAI) and above-ground biomass (AGDM). Analysis of this large volume of data is ongoing.

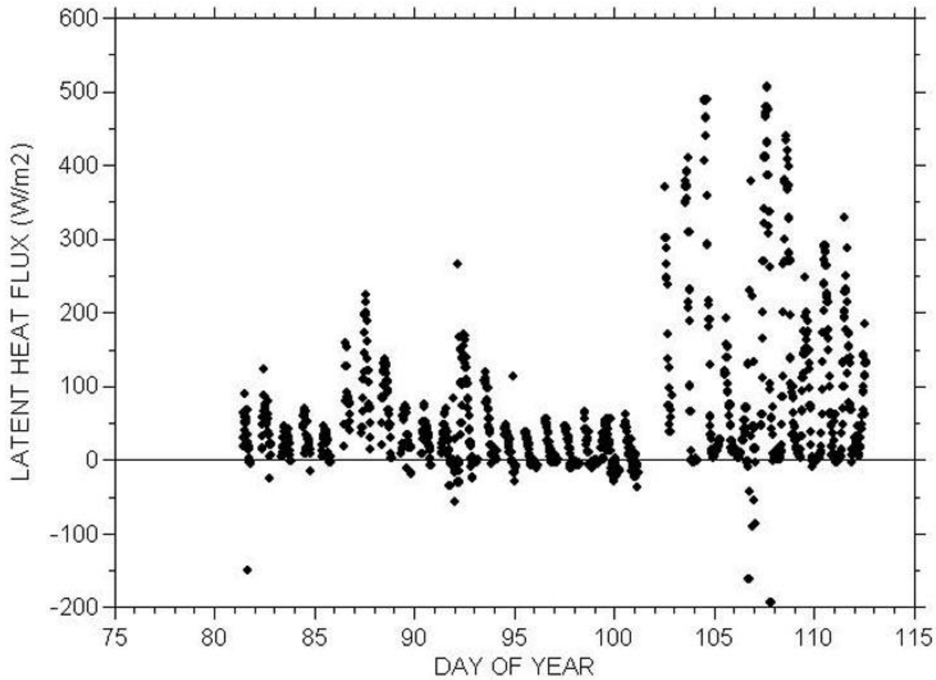


Figure 26. Latent heat flux resulting from soil evaporation measured at Field 11 during the 2009 study.

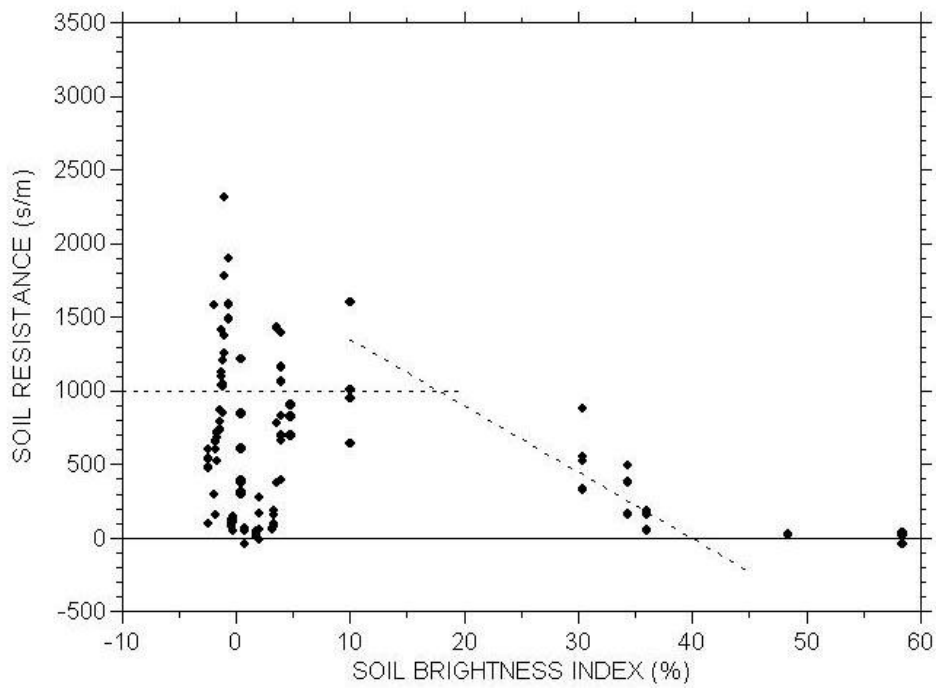


Figure 27. Relationship between soil surface resistance and soil brightness.

An extensive re-examination of data acquired in 2008 for Fields 01 (drip-irrigated cotton) and 29 (dryland cotton) was performed to test our procedure for estimating crop water use (CWU) from satellite observations and weather network data. This included EC and surface energy balance measurements for a number of days during the growing season, along with satellite observations of the fields. Figure 28 shows the GC curves for each field derived from the Landsat images acquired during the study. As might be expected, Field 01 showed considerably more canopy development compared to Field 29.

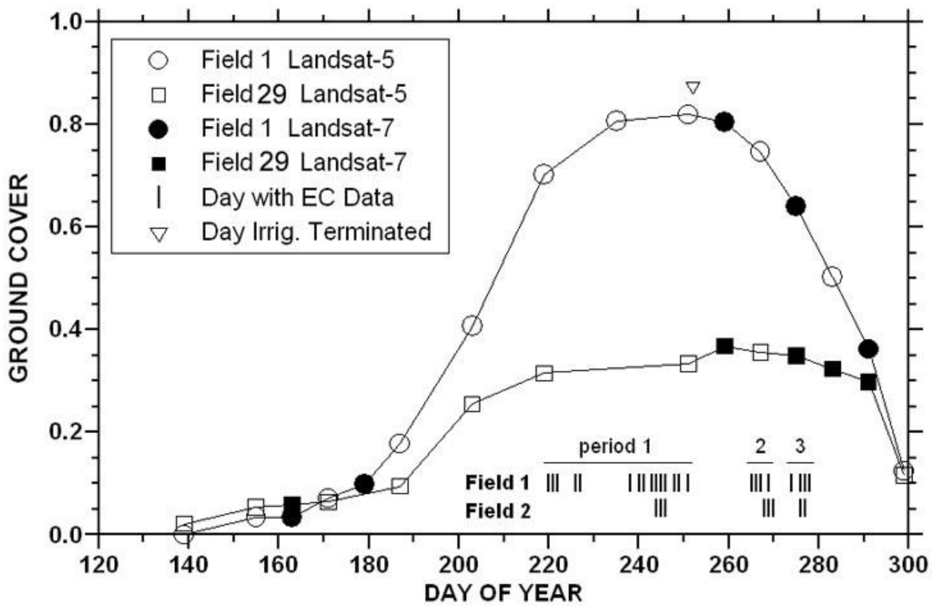


Figure 28. Crop ground cover determined for Field 01 and Field 29 in 2008 from Landsat imagery.

Data from Fields 01 and 29 were used to evaluate the relationship,

CWU = PET*GC*Fs [Eq. 1]

where PET is the potential evapotranspiration of the crop assuming complete ground cover, GC is the ground cover estimated from satellite observations, and Fs is stress factor that ranges from 1 (indicating no water stress) to 0 (indicating maximum water stress). Fs indicates the degree to which CWU is affected by stomatal closure in the crop canopy. For crops acclimated to their environment, Fs should be approximately 1.

For Field 01 during Period 1 (prior to the termination of irrigation), results show that Equation 1 did a good job of estimating CWU with Fs = 1 (Figure 29). This shows that, during the period of irrigation, CWU was controlled more by leaf canopy development than by leaf stomata. Following the termination of irrigation for Field 01 on day 252 (September 8), the crop rapidly depleted soil moisture and began losing much of its leaf canopy. This leaf senescence alone was not sufficient to maintain hydration of the plants, so the plants also used stomatal closure to reduce their transpiration rate. This is indicated by the results presented in Figures 30 and 31. The slopes of the regressions in these figures show that the values of Fs for periods 2 and 3 were 0.86 and 0.62, respectively. This demonstrates that when cotton is grown with abundant irrigation over most of the growing season and then the irrigation is shut off, the plants will go into a severe stress period in which rapid leaf senescence and stomatal closure will be used to reduce the transpiration rate and conserve remaining soil moisture reserves.

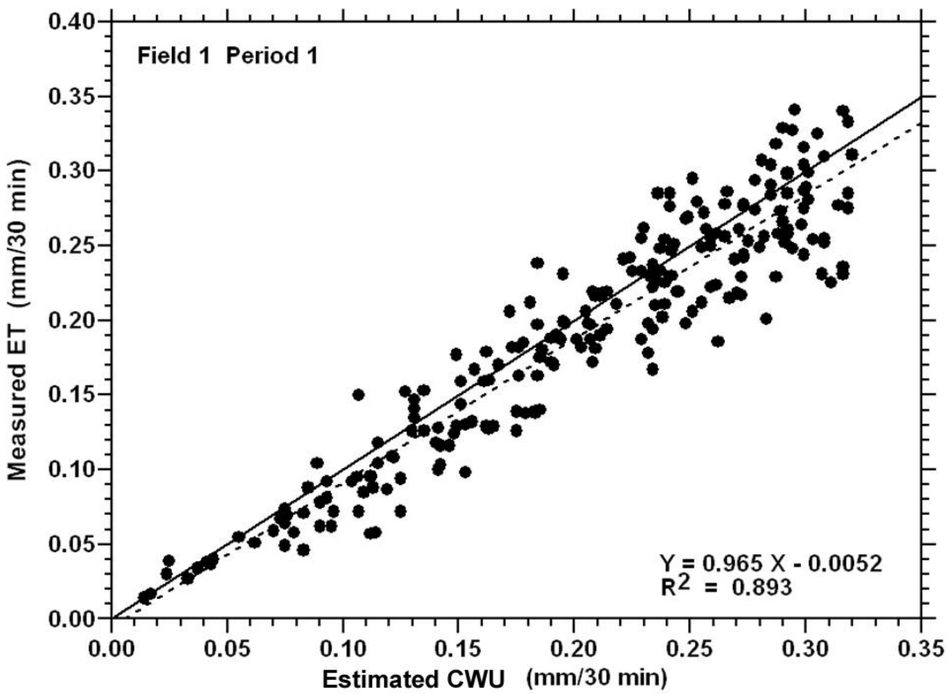


Figure 29. Comparison of CWU for Field 01 prior to the termination of irrigation estimated using Equation 1 with Fs = 1 and actual crop ET measured with the EC system.

Results of estimating CWU for Field 29 using Equation 1 with Fs = 1 are shown in Figure 32. These results indicate that, even though the crop in this field was not irrigated and relied only on rainfall, it was acclimated to its environment. Like Field 01 prior to the termination of irrigation, CWU for Field 29 was controlled more by leaf canopy development than by leaf stomata. These results show that, when soil moisture conditions are not changing rapidly, the crop adjusts its canopy leaf area in response to the available soil moisture. This is generally what we observe in the field—irrigated crops have greater leaf canopy development than dryland crops. Adjustment of canopy size is a mechanism for acclimating the crop to its environment. Stomatal closure is necessary only when the system gets out of balance, as when the irrigation is suddenly turned off.

Results from this study validate our procedure for estimating CWU from remotely sensed GC and weather network data (used to calculate PET). Incorporation of this method into an irrigation scheduling program would allow estimates of CWU and depletion of soil moisture to be computed specifically for individual fields in a region.

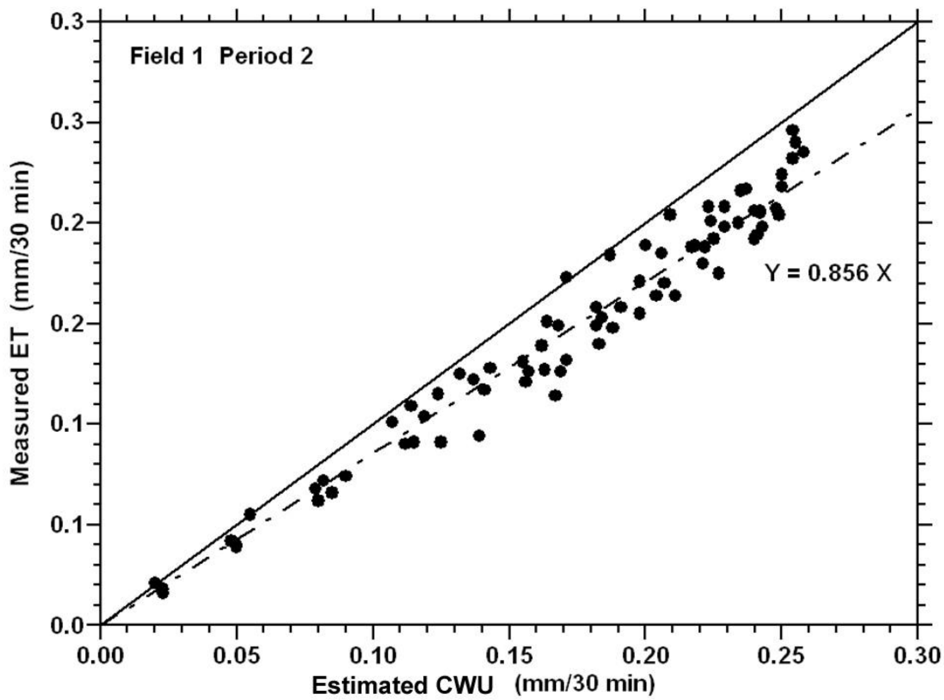


Figure 30. Comparison of CWU for Field 01 immediately after the termination of irrigation (period 2) estimated using Equation 1 with Fs=1 and actual crop ET measured with the EC system.

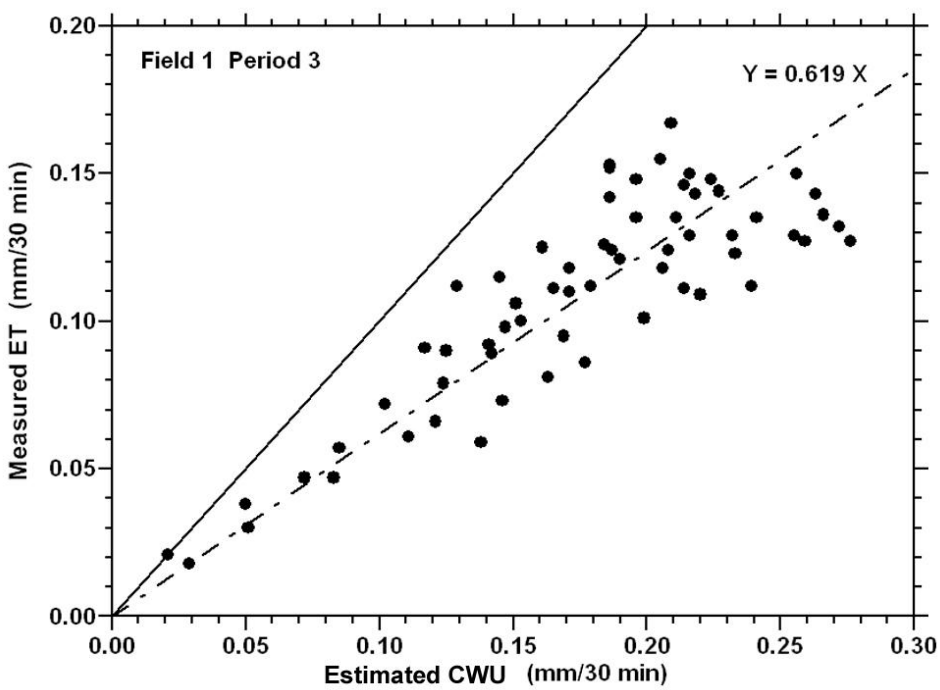


Figure 31. Comparison of CWU for Field 01 after termination of irrigation (period 3) estimated using Equation 1 with Fs=1 and actual crop ET measured with the EC system.

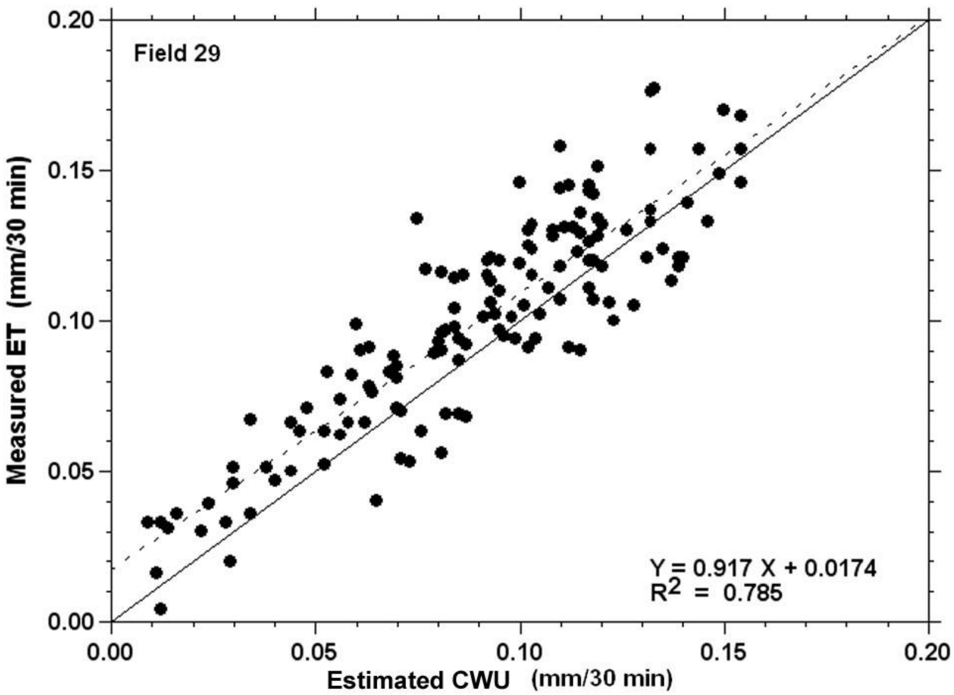


Figure 32. Comparison of CWU for Field 29 estimated using Equation 1 with Fs=1 and actual crop ET measured with the EC system.

Using the satellite data from the Landsat acquisitions listed in Table 26 and daily weather data from the West Texas Mesonet station at Plainview, TX, we used Eq. 1 to calculate estimates of the daily CWU for fields in TAWC for the 2009 growing season. These daily CWU values were then summed over the period from planting to harvest to produce seasonal estimates of CWU (Table 26). These results are preliminary, and are presented for field crops only. Estimates for fields with alfalfa and grass await information on cutting dates for the estimation of their CWU.

Table 26. Preliminary estimates of seasonal crop water use (CWU) for fields in the TAWC Project in 2009.

SITE	FIELD	CROP	Crop Water Use (inches)
2	1	Cotton	18.26
3	1	Cotton	14.26
3	2	Grain Sorghum	17.69
4	1	Cotton	15.36
4	2	Grain Sorghum	16.74
6	3	Cotton	12.87
6	4	Corn	25.45
9	2	Cotton	10.46
10	2	Cotton	18.43
11	1	Cotton	8.86
11	2	Grain Sorghum	14.98
11	3	Cotton	12.87
14	2	Cotton	13.16
15	5	Cotton	16.39
15	6	Cotton	9.73
15	3	Cotton	9.26
15	4	Cotton	14.14
17	3	Sunflower	22.11
18	2	Cotton	13.55
20	1	Cotton	18.32
20	2	Corn	27.63
21	2	Forage Sorghum	16.98
22	1	cotton	13.36
22	2	Cotton	15.17
23	3	Forage Sorghum	14.03
23	4	Forage Sorghum	13.23
23	5	Forage Sorghum	17.64
23	6	Forage Sorghum	16.53
24	1	corn	22.53
24	2	Sunflower	15.41
26	1	Sunflower	21.68
26	2	Corn	25.47
27	1	corn	27.30
27	3	Cotton	18.46
27	4	corn	26.24
28	1	Cotton	18.46
29	1	cotton	7.16
29	3	cotton	7.66

PUBLICATIONS AND PRESENTATIONS RELATED TO TAWC

Rajan, N., and S. J. Maas. 2009. Mapping crop ground cover using airborne multispectral digital imagery. Precision Agriculture 10(4): 304-318.

Rajan, N., P. H. Gowda, Matthew Baddock, S. J. Maas, S. Basu, and S. Nair. 2009. Vegetation cover mapping at multiple scales using MODIS, Landsat, RapidEye, and Aircraft imageries in the Texas High Plains. Fall meeting, American Geophysical Union. 12-18 December, San Francisco, CA.

Maas, S. J., and N. Rajan. 2009. Biomass indices. Cotton Incorporated Precision Cotton and COTMAN meetings, 10-12 November, Austin, TX.

Rajan, N., S. J Maas, and J. C. Kathilankal. 2009. Evapotranspiration of irrigated and dryland cotton fields determined using eddy covariance and Penman-Monteith methods. Abstracts, Annual Meetings, Amer. Soc. Agronomy. 1-5 November, Pittsburgh, PA. (CD-ROM)

Maas, S. J., and N. Rajan. 2009. Relation between soil surface resistance and soil surface reflectance. Abstracts, Annual Meetings, Amer. Soc. Agronomy. 1-5 November, Pittsburgh, PA. (CD-ROM)

Maas, S. J., and N. Rajan. 2009. Evaluation of the bare soil line from reflectance measurements on seven dissimilar soils. Joint Annual Meetings, Western Society of Crop Science and Western Society of Soil Science. 22-24 June, Fort Collins, CO.

TASK 6: COMMUNICATIONS AND OUTREACH

Dr. David Doerfert
Morgan Newsom
Heather Jones

During this past year, several activities were designed and implemented towards the goal of expanding the community of practice that is developing around agricultural water conservation. The most visible highlight of the year was the Farmer Field day conducted in February. More specific details of this and additional accomplishments are described below under each of the four communication and outreach tasks.

6.1 *Increase awareness, knowledge, and adoption of appropriate technologies among producers and related stakeholder towards the development of a true Community of Practice with water conservation as the major driving force.*

6.1 — Accomplishments

Farmer Field Day (February 2010). The majority of time and resources spent this past year were on planning and implementation of the TAWC Farmer Field Day that was conducted at the Unity Center in Muncy, TX on Wednesday, February 3, 2010. Planning activities included development of the morning program, coordination of speakers, facilitates and refreshments including a catered lunch, and securing CEUs for participants.

In addition to planning the program, several promotional activities beyond the area farm shows were conducted. These activities included placement of the save-the-date cards at agribusinesses frequented by producers, creating and mailing press releases to newspaper and producer-oriented magazine sources, appearances on agriculture radio and TV programs (Lubbock & Plainview), and advertising on four local agriculture broadcast outlets (Lubbock, Plainview & Amarillo radio & Lubbock TV).

Despite a day-long rain, 93 producers attended the workshop. Based on post-workshop evaluation results submitted by the participants, attendees were very satisfied with all aspects of the program. Beyond the responses to each program component, it was interesting to note that those who completed the evaluation traveled as far as 280 miles to attend the program with 13 (40.6%) traveling at least 50 miles to attend the program providing evidence to the ever-expanding reach of the TAWC project.

In addition, attendees had the opportunity to complete a notification card related to the new TAWC management tools being developed. When the tools are ready, these individuals will be contacted to let them know how to obtain these new tools. Twenty-five attendees completed the notification cards. This contact will occur during the 2010 year. Research is being planned to examine the adoption of these water management tools by producers and others.

Informational Items Created & Disseminated. Continuing on the previous work of creating an understanding of what is happening at each of the TAWC sites, individual site summary sheets have been created for each site based on the 2007 and 2008 growing seasons. These sheets are being added to the TAWC redesigned web site's searchable database allowing individuals to see up to four years of results for each project field site.

New materials were also created for use in the TAWC booth at the 2009 Amarillo Farm & Ranch Show including a "save the date" card for the 2010 field day. In addition, the booth was redesigned with new display materials to highlight research results uncovered by the project researchers.

As part of a policy-maker site visit in August 2009, a 24-page document summarizing the past achievements, current activities, and future directions of the project was created. Additional copies of this document were disseminated during the area farm shows and at the 2010 Farmer Field Day.

As mentioned earlier, the TAWC project web site was redesigned. In addition, a new sub-brand and logo were created for the web site in anticipation of the completion of the new management tools being developed in the project. These tools will be described in the TAWC Solutions portion of the web site and should become available in April 2010.

Presentations and Project Promotions. Dr. David Doerfert, graduate assistant Heather Jones, and two other graduate assistants not directly involved in the TAWC project staffed an information booth at the 2009 Amarillo Farm & Ranch Show (December 1-3, 2009) and the 2010 Lubbock Farm & Ranch Show (February 9-11, 2010). Project descriptions and summaries of research were distributed to attendees. Approximately 150 "save the date" card were also distributed for the 2010 field day were distributed in Amarillo. Lower show attendance in Lubbock resulted in approximately 30 individuals stopping by the booth for information.

6.2 Project communication campaign planning, implementation, and related research activities.

As the communications and outreach activities move from the initial efforts to create awareness of the TAWC project and the launch of a community of practice to activities that will facilitate the adoption of the research results and best practices produced in the past four years, additional communication planning and research activities were conducted to achieve the desired future outcomes. The items that were accomplished are listed below.

6.2a — Accomplishments: Communications Planning. Dr. Doerfert attended the Texas Ag Forum in Austin on June 22, 2009. The program focused on the impact of climate change on agriculture including potential impact on water. The purpose of attending this forum was to explore the potential of including additional climate-change-related variables into the TAWC project.

Photo documentation of the individual field sites continued with six visits during 2009. These photographs were used in the preparation of a variety of information resources as a visual indicator of the project activities and results. Additional project photos were taken during tours of the project sites and at various related events including the Farmer Field Day.

Finally, a clipping service was continued to help the project monitor the extent and type of print media coverage on the TAWC project. An initial content analysis illustrated that there is very little in the extent of coverage related to water with the majority of the news content focused on urban water use.

6.2b — Accomplishments: Research. Dr. Doerfert met with representatives from six universities in Dallas on November 19-21, 2009 to begin efforts that would secure funding to expand the social science research efforts of the TAWC project. Efforts are to target a future RFP on rural community resiliency with water management being a major factor examined in that research.

6.3 *Creation of longitudinal education efforts that include, but are not limited to, Farmer Field Schools and curriculum materials.*

6.3 — Accomplishments. Dr. Doerfert and Heather Jones conducted a teacher workshop during the Texas Agriscience Educator Summer Conference on July 29, 2009 in Lubbock. This included a 90-minute workshop to help high school teachers incorporate water management and conservation into their local programs. Four classroom-ready lessons were prepared and given to all participants. These lesson plans were also posted to the TAWC workshop.

As her master's thesis, graduate assistant Heather Jones collected data from the participants to determine the effectiveness of the workshop in changing water management-related instructional practice intention. The results of this thesis will be reported in March 2010. Additional data will be collected in May 2010 to determine if these teachers followed through with their intentions during the past school year. The study will be completed by August 2010.

Dr. Doerfert and Heather Jones were also involved with the August 17-18, 2009 on-site visitation of the TAWC project by state and federal officials. This involvement included creating a 24-page document summarizing the past achievements, current activities, and future directions of the project as well as the photo documentation of the event. It is hoped that this expanded level of awareness by those involved in federal and state policy development will increase the utilization of the results of this project.

6.4 *It is the responsibility of the leader for this activity to submit data and reports as required to provide quarterly and annual reports to the TWDB and to ensure progress of the project.*

6.4— Accomplishments. Timely quarterly reports and project summaries were provided as requested.

TASK 7: INITIAL FARMER/PRODUCER ASSESSMENT OF OPERATIONS

Dr. Calvin Trostle

Support to Producers

Visited with fifteen producers during 2009 about their operations as part of the ongoing producer assessment of their needs and what crop information they would like to have for their operation. Numerous research and Extension reports were provided as needed in the TAWC area.

Common questions among producers in 2009 centered on grain sorghum, wheat, sunflower, and split pivot irrigation scenarios whereby producers are choosing two different crops to spread water use (and demand) rather than require irrigation on a full circle at one time.

Field Demonstrations

A) Lockney & Brownfield Range Grass & Irrigation Trial

See report below.

B) Wheat Grain Variety Trial

A variety trial was completed on the R.N. Hopper farm just south of the TAWC demonstration area. As noted in the report below, a late March freeze affected the test. An additional test for 2009-2010 was initiated at Jody Foster's farm.

Opportunities to Expand TAWC Objectives

Project awareness: Commented on project on three different radio programs, answered producers phone calls, and information and the approach that the TAWC project is taking has helped shape at least four other programs and Extension activities in the Texas South Plains.

Leverage of funding: 1) Received two-year federal Ogallala Aquifer Project (OAP) in support of perennial grass trial sites ($12,500), which was implemented for the 2009 summer season.

Educational Outreach

Participated in 2 county Extension meetings covering the TAWC demonstration area in 2009, including the Floyd-Crosby Crop Conference in January (two talks; grain sorghum & wheat) and the fall Floyd County crop tour where CRP was discussed (what to do with expiring contracts).

Existing TCE publications and reports were provided in the TAWC target area to at least 16 producers.

Support to Overall Project

Activities include attending five monthly management team meetings and/or producer advisory board meetings.

Report A: Perennial Grasses for the Texas South Plains: Species Productivity & Irrigation Response

Project conducted at: Eddie Teeter Farm, Lockney, Texas (seeded April 2006)
Mike Timmons Farm, Brownfield, Texas (initial seeding, June 2008; overseeded, May 2009)

Project Overview

Beginning in 2005 the Texas Alliance for Water Conservation (TAWC) participants frequently discussed the slow but steady trend of producers converting cropland back into permanent grassland. Some of this land could very well seek to irrigate perennial grasses if that would be a more efficient and profitable use of groundwater resources. The Lockney trial site was initiated in 2006, and a second site was initiated in Terry County in 2008 (and overseeded in 2009) as an outreach of the TAWC project into surrounding areas. The Ogallala Aquifer Project (OAP) began partnering with the current project in 2009 to supplement support for the project in fulfilling OAP goals in the region.

As noted in previous reports the primary objective is to determine which perennial grass species and varieties are adapted to the region and productive under conditions ranging from dryland to ~1" irrigation per week (late-April to early October).

Lockney Site

Irrigation was implemented as noted in Table 27 with an annual rainfall in 2009 16.2". Irrigation was applied using a measured flow rate to apply the desired number of gallons per plot area.

Table 27. Lockney perennial grass trial rainfall and irrigation, 2009.

2009 Lockney Rainfall	Monthly Rainfall	Cumulative 2009 Total	Irrigation Levels (inches)		
Month	*(inches)*	*(inches)*	*Level 0*	*Level 1*	*Level 2*
January	0.1	0.1	DRYLAND		
February	0.5	0.6			
March	0.4	1.0			
April	1.3	2.3			
May	1.0	3.3		1.0	2.0
June	2.9	6.2		2.0	4.0
July	3.1	9.3		1.0	2.0
August	2.2	11.5		1.0/1.0*	2.0/2.0*
September	2.5	14.0		1.0	2.0
October	0.7	14.7			
November	0.2	14.9			
December	1.3	16.2			

*Harvest was conducted on August 19th. One August irrigation occurred before and one after the harvest date

Yield data for 2009 as well as a 3-year summary is listed in Table 28, including the Aug. 19, 2009 harvest for yield. An additional harvest was conducted in October (representing late August to early October growth), but the labels were mis-handled, and that data was thus lost.

The cumulative trial grass yield by species ranged from ~2,000 lbs./A (buffalograss) to over 13,000 lbs./A (Alamo switchgrass), with WWB Dahl & Caucasian old world bluestems and Kleingrass yielding over 10,000 lbs./A (trial average ~8,400 lbs./A when averaged across all irrigation levels). For all grasses, the cumulative dryland grass production level averaged 5,500 lbs./A., and 6" and 12" of supplemental irrigation increased forage yields about 1,300 lbs./A for the low level or irrigation, and an additional 500 lbs. for the moderate irrigation level (roughly the inches of irrigation from 6 up to 12" over the three-year period). This latter yield increase based on the yield return per unit of irrigation water readily appears to not be justified, and it is poor use of limited groundwater resources. After three years the old world bluestems WWB Dahl and Caucasian as well as sideoats grama appeared to use irrigation water more productively. In contrast, irrigation levels have not greatly increased the yield of Alamo switchgrass, which has demonstrated by farm the greatest utilization of rainfall and soil moisture to achieve high yields (over, 9,000 lbs./A). Irrigation over the past three years has not greatly increased switchgrass yield. The above old world bluestems and Kleingrass were other grasses that made the most of naturally rainfall in contrast to the remaining perennial grasses.

Terry County Grass Species Stand Establishment

Similar to the trial at Lockney, TAWC determined that an area of prime interest in perennial grasses and the potential to convert irrigated agriculture back to dryland centered on the highly sandy soils of the southwest South Plains. With slight modification of the grasses planted at Lockney, we prepared land at Mike Timmons farm east of Brownfield in 2008, but had significant trouble with weeds in the test area once irrigation was introduced. This test site was overseeded in May 2009, and though weeds continued to present a major problem, fair or better stands have now been achieved with most grasses (poor stands remain in some individual plots, particularly sideoats grama, blue grama, and Dahl and Caucasian bluestems. Banvel and atrazine were again applied mid-season to try to knock the weeds back and the trial site was mowed. Bulk seed was placed on plots again in early 2010 in an attempt to increase stands in blank areas. Grasses were seeded in late May once irrigation was available (about six weeks later than desired). Grasses that established fairly well in 2008—Kleingrass, Spar old world bluestem, and the NRCS recommended natives blend (~20% each: Plains bristlegrass, Blackwell switchgrass, Hatchita blue grama, Haskell sideoats grama, Sand lovegrass) have good establishment in the test. These grasses give confidence to potential producers that the simplicity and ease of establishment are valuable considerations for choosing a grass in the sandier southwest South Plains.

Table 28. Perennial grass trial yield results for 2007-2009 cuttings, Lockney, Texas. Irrigation levels in 2009 peaked at 10" (Level 2) through early August. Table does not reflect additional data from stockpiled forage, 2008, or the lost cutting (mislabeled) for Fall 2009. Trial was established in April 2006.

Entry	Perennial Grass Species	Variety	Total July/Nov 2007 Clips	Irrigation Level^	Yield @ Irrigation Lbs./A. 8/08	Avg. Yld. All Irrig. Levels 2008	Yield @ Irrigation Lbs./A 8/19/2009	Avg. Yld. All Irrig. Levels 2009	Avg. 3-Yr Total Yld. Each Irrig. .07-09	Avg. 3-Yr Total Yld. ALL Irrig .07-09
1	Buffalo-grass	Plains	2,551	0	1,464	1,515	1,880	2,157	1,344	2,074
				1	1,459		2,007		1,322	
				2	1,623		2,584		1,703	
2	Sideoats Grama	Haskell	9,174	0	3,941	5,175	2,564	4,469	3,080	6,273
				1	5,147		4,607		4,094	
				2	6,435		6,238		5,287	
3	Blue Grama	Hatchita	9,399	0	4,063	4,144	3,758	6,475	3,674	6,672
				1	3,950		6,883		4,695	
				2	4,418		8,783		5,473	
4	NRCS Natives Blend	Three grasses ‡	8,517	0	3,622	5,993	3,810	5,617	3,258	6,709
				1	7,098		5,502		5,032	
				2	7,260		7,538		5,962	
5	Switch-grass	Alamo	18,056	0	15,975	17,265	3,973	5,649	9,332	13,657
				1	17,751		5,913		10,200	
				2	18,070		7,062		11,015	
6	Kleingrass	Selection 75	14,447	0	8,708	10,391	4,378	6,569	6,268	10,469
				1	11,228		7,377		8,442	
				2	11,237		7,953		8,451	
7	Old World Bluestem	Spar	14,471	0	5,719	8,919	3,258	5,323	4,591	9,571
				1	8,764		5,845		6,953	
				2	12,274		6,865		8,329	
8	Old World Bluestem	WW-B Dahl§	16,007	0	8,813	11,637	4,565	5,797	6,677	11,147
				1	12,565		6,534		8,975	
				2	13,533		6,292		8,575	
9	Old World Bluestem	Caucasian	13,110	0	8,252	10,874	5,421	6,709	6,292	10,231
				1	11,271		7,649		7,939	
				2	13,099		7,058		8,205	
12	Indian-grass	Cheyenne	5,594	0	5,284	6,485	2,926	4,671	3,522	5,583
				1	7,159		4,800		4,707	
				2	7,011		6,286		5,134	
10	ermuda-gras	Ozark sprigged	15,801	0	7,805	6,281	3,123	4,528	5,420	8,870
				1	5,713		4,959		5,348	
				2	5,324		5,501		5,667	
11	Bermuda-grass	1:1 Giant/Common seeded¶	14,486	0	6,905	8,218	3,111	4,584	4,909	9,096
				1	8,796		4,927		6,375	
				2	8,954		5,715		6,705	
	Trial Averages		11,801	0	6,713	8,075	3,564		4,864	8,363
				1	8,408		5,583		6,173	
				2	9,103		6,489		6,709	

P-Value (Variety)	<0.0001	<0.0001
P-Value (Irrigation)	<0.0001	<0.0001
P-Value (Variety X Irrigation)	0.1008	0.0003
Fisher's PLSD (0.10)--Variety¤	1,429	519
Fisher's PLSD (0.10)--Irrigation¤	714	259
Coefficient of Variation, CV (%)	55.4	36.1

^Due to high early season rainfall, irrigation was applied only on 31 July and 24 August (1" each for '1'; 2" for '2').

‡50% Hatchita, 40% Haskell, 10% green sprangletop (Natural Resources Conservation Service blend for Floyd Co.).

¤Values in the same column that differ by more the PLSD are not statistically/significantly different at the 90% confidence level.

Table 29. Initial perennial grass trial stand ratings, Brownfield, 2008-2009. Trial became excessively weedy once irrigation began, and focus shifted to weed control with overseeding May, 2009.

Entry	Perennial grass species	Variety	Stand Rating‡		
			7/9/08	11/5/08	10/1/09
1	Buffalograss	Plains	0.5	0.1	2.0
2	Sideoats grama	Haskell	1.2	0.9	1.7
3	Blue grama	Hatchita	1.0	0.7	1.8
4	Natives Blend	Terry Co. NRCS Mix†	2.0	1.4	2.7
5	Switchgrass	Alamo	1.0	0.7	2.0
6	Kleingrass	Selection 75	2.3	2.8	3.0
7	Old world bluestem	Spar	1.0	1.8	3.0
8	Old world bluestem	WW-B Dahl	0.3	0.8	1.8
9	Old world bluestem	Caucasian	0.7	1.0	1.5
10	Bermudagrass	Ozark sprigged	Not yet sprigged		
11	Bermudagrass	Giant/Common,1:1 (seeded)	Not yet seeded		
12	Dahl OWB for overseed	Yellow sweet clover	Legume not yet added. Will be seeded in Fall 2010 with better stands.		
13	Dahl OWB for overseed	Alfalfa			
14	Dahl OWB for overseed	Overton 18 rose clover			
15	Dahl OWB for overseed	Hairy vetch			

†60% sideoats grama, 30% blue grama, 10% green sprangletop

‡0 = none, 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent

Bermudagrass as well as the interseeding of four different legumes into stands of WWB Dahl old world bluestem were delayed until 2010 due to the focus on trying to control weeds.

Education Outreach

One educational program was hosted at the Lockney grass trial site in 2009 for a local tour. Additional tour stops are anticipated for 2010 and a summer or fall tour stop for the Terry County crop tour is planned for the Brownfield site in conjunction with the annual Extension/NRCS/FSA farm tour in Terry County.

Report B: Irrigated Wheat Grain Variety Trial Results, Floyd County, Texas, 2009

Irrigated grain trials for wheat were added in the fall of 2008 in Floyd County to represent the eastern South Plains. Due to the high profile of TAWC projects, this project was located in the water conservation project. Duplicate tests occur in Yoakum, Castro, and other counties in the Texas Panhandle. Due to the pumping and water limitation producers are considering minimizing summer irrigation to ensure they are able to irrigate at agronomic and economic levels.

The Floyd County trial was seeded November 4 at the R.N. Hopper farm at a seeding rate of 1.1 million seeds/acre (on average about 67 lbs./A). The test received significant damage from the March 27-28 freeze, but did recover to average 36 bu/A for all varieties. This was a surprising yield in light of how the test area appeared after the freeze, when in fact we believed that the test, with modest yield potential prior to the freeze, would have reduced yield by over 50%.

Trial results were highly variable

Trial results statistically noted that there were substantial and strong significant differences among varieties, however, a measure of variability (coefficient of variation) notes that the highly variable results within varieties makes these results less meaningful in terms of comparing one variety to another. Nevertheless, several results are of note.

1) Bearded wheat yields (34 varieties, non-Clearfield lines), yielded 38.3 bu/ whereas seven beardless wheats averaged only 28.9 bu/A. Typically we see a yield reduction of 10-20% for beardless wheat vs. recommended grain varieties. Deliver was the only beardless wheat variety in the trial that approached trial yield averages. Extension recommends that if producers believe there is a good chance you will go to grain to avoid planting beardless wheat. Many years of data demonstrate that no beardless wheats, even the newer lines like Deliver, Longhorn, and TAM 401 have sufficient yield potential to be considered for planned grain harvest.

2) Texas AgriLife publishes lists of recommended wheat varieties for full irrigation, limited irrigation, and dryland (see table footnote). In this trial the yields of the seven wheat varieties that are Picks for Texas High Plains irrigated production, when averaged together actually yielded less than the average yield of bearded wheats. This average, 37.8 bu/A was pulled down significantly by TAM 304 which performed poorly in this particular trial.

3) Did the March freeze hurt early maturity wheats? In most years, early maturity wheats like TAM 110 and Jagger, and now other lines like TAM 112 are more susceptible to a late spring freeze because they are closer to heading. More new commercial wheat varieties are now rated as early maturity (Armour, Art, Fuller, Jackpot, Overley, Shocker), but the yield of early maturity wheats in this trial was 39.9 bu/A, actually higher than the trial average by a couple of bushels. TAM 112's yield was below average in this trial, and some fields of this variety in 2009 were severely damaged especially south of Lubbock. Early maturity wheat may have a risk if heading and at flowering, but an exceptionally late freeze could damage 112

less than other later maturity varieties if they are at those highly sensitive growth stages. Also, early maturity wheats in general in some years may have reduced exposure to hot spring temperatures vs. later maturing wheats.

4) NK 812 is a popular variety with producers on sandy soils in the Southwest South Plains in great part due to its ability to provide excellent ground cover relative to other wheats. First-year yields of this variety in Floyd County were poor (32.7 bu/A), similar to yield trial results from Yoakum & Gaines Counties.

5) Texas AgriLife Extension Service agronomy in Lubbock has begun testing of Clearfield herbicide tolerant varieties in the South Plains and southwest Panhandle. First-year results from Yoakum County in 2009 are similar to Floyd County results in this trial.

Dryland Considerations

Of tested varieties TAM 111, TAM 112, TAM 304, Jagalene, Hatcher, and Fuller have been noted for their recent performance in strictly dryland production in other areas of West Texas.

Greenbug and Russian Wheat Aphid Resistance

Greenbug resistant TAM 110 is being phased out in lieu of TAM 112 as the latter has slightly higher grain yield, better disease resistance (essentially the best available resistance to Wheat Streak Mosaic Virus, transmitted from volunteer wheat by the wheat curl mite), and better grain milling quality. Hatcher's exceptional performance may be attributed to RAW resistance.

Other Management Tips for 2009-2010

Seed Quality Guidelines—Test weight of ≥58 lbs./bu and germ ≥85%—is a key for South Plains wheat production especially as many acres are planted late in cooler conditions after cotton or peanut harvest.

Seeding Rate—This irrigated test included using TAM 111 for 30, 60, 90, and 120 lbs./A. No trend was observed in this first-year test. Extension suggests 60 lbs./A is a good base seeding rate for irrigated grain, but rates should increase for late plantings to perhaps 90 lbs./A if seedings occur in late November into December.

Planting Date—Optimum planting dates for wheat in the Lower South Plains should target around October 25. I would not be concerned about seedings in the first week of November, but after that gradual risk of reduced yield potential increases. Seedings that occur in early December can provide similar yields compared to optimum planting dates in some years, but expect a long-term reduction in yield potential of ~25% (worse in some years). This notes the urgency to hasten wheat seeding after peanuts and cotton to increase chances for good stand establishment prior to lasting cold.

Nitrogen for Wheat Grain Production—Without soil test data, Texas AgriLife Extension suggests 1.2 lbs. N per bushel of yield goal. This is a reliable rule of thumb. The number may be adjusted up if residual soil N fertility is poor, down if residual N fertility is good. Topdressing N typically targets about 1/3 of N in the fall with 2/3 in the late winter/early spring BEFORE jointing (see below).

Timing of 2010Topdress N—Extension continues to observe many producers making topdress N applications well after jointing. We will address this further over the winter, but delayed N applications much past jointing (growing point differentiates to determining maximum potential spikelets per head and seeds per spikelet; growth often becomes more erect and hollow stem is usually observed a couple days after jointing starts) have reduced the effectiveness of N to increase grain yield. Hence topdress N applications in Gaines, Yoakum, Terry, and Dawson Cos. are best targeted most likely in mid-February and probably no later than early March.

Herbicide Options for Wheat—Consult the 2008 Extension small grains weed control guide at http://varietytesting.tamu.edu/wheat/otherpublications/B-6139%202008%20Weed%20Control.pdf

For further information on recent Texas High Plains wheat variety trials, consult the multi-year irrigated and dryland summary as well as Extension's list of recommended varieties at http://lubbock.tamu.edu/wheat or contact your local county/IPM Extension staff or Calvin Trostle.

Table 30. Floyd County wheat variety trial, RN Hopper farm, 2008-2009.

Floyd Co. Wheat Variety Trial, R.N. Hopper Farm, 2008-

Conducted by Calvin Trostle, Extension agronomy,
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AgriLIFE EXTENSION Texas A&M System

Seeded 11/4/09; 1,100,000 seeds/A Freeze damaged, 3/27/09 VARIETY	Source	Seed Test Wt. (lbs./bu)	Visual Seed Rating†	% Germ	Seeds per Lb.	Height (in.)	Harvest Test Wt. (lbs./bu)	Yield Bu/a at 14% H2O
AP06T3519	AgriPro (Exptl.)	59.0	4	100	15,200	21	54.4	34.2
AP06T3832	AgriPro (Exptl.)	59.9	4	99	14,700	23	51.7	35.9
AP06TW4822 (White)	AgriPro (Exptl.)	58.8	4	100	13,600	23	52.9	31.6
Armour	WestBred	61.0	4	98	11,900	19	54.2	40.2
Art	AgriPro	58.6	3	98	17,000	22	53.7	43.6
Bill Brown	Colo St.	63.0	4	100	13,800	23	56.6	48.9
Billings	Okla. St.	58.3	4	98	13,600	23	53.1	35.5
Bullet	Okla. St.	61.2	4	100	15,800	24	56.0	30.1
Doans	AgriPro	63.4	4	98	14,300	22	54.5	30.3
Dumas	AgriPro	62.8	4	97	15,800	23	54.8	41.6
Duster	Okla. St.	60.9	4	99	16,500	22	54.2	34.0
Endurance	Okla. St.	59.9	4	99	13,900	22	54.3	43.1
Fannin	AgriPro	62.9	4	98	15,300	21	55.4	31.8
Fuller	Kansas St.	62.3	4	100	14,800	22	53.5	44.8
Hatcher	Colo St.	60.2	4	99	16,300	24	54.9	40.5
Jackpot	AgriPro	60.0	4	98	13,200	21	53.0	34.0
Jagalene	AgriPro	62.9	4	100	12,700	23	54.4	40.2
Jagger	Kansas St.	62.4	4	100	14,100	21	54.0	37.2
OK04525	Okla. St. (Exptl.)	59.8	4	100	16,900	25	55.8	48.7
OK05526	Okla. St. (Exptl.)	58.6	4	97	14,300	24	55.0	45.6
OK 101	OK Found Seed	60.3	4	98	15,700	22	52.9	30.6
Overley	Kansas St.	62.0	4	100	15,300	24	54.4	41.6
Santa Fe	WestBred	53.9	4	97	15,600	23	54.9	48.8
Shocker	WestBred	55.1	2	94	17,100	24	53.7	51.2
T81	Trio Research	55.4	3	98	23,900	23	55.0	41.2
T136	Trio Research	55.9	3	100	18,800	24	54.9	37.9
TAM 111	Texas AgriLife	60.9	4	93	16,200	26	55.6	46.0
TAM 112	Texas AgriLife	57.2	4	98	16,000	23	54.1	33.5
TAM 203	Texas AgriLife	58.4	4	98	16,600	21	53.6	26.7
TAM 304	Texas AgriLife	59.5	4	100	15,200	21	51.4	25.8
TAM W-101	Texas AgriLife	52.7	2	98	19,800	22	55.5	29.8
TX01V5134RC-3	TX AgriLife (Exptl.)	62.1	4	100	12,700	20	54.1	32.8
TX02A0252	TX AgriLife (Exptl.)	60.7	4	99	16,200	25	54.5	39.5
TX04V075080	TX AgriLife (Exptl.)	59.3	4	97	12,600	21	53.1	45.3
Beardless Wheats								
AP06TA4520	AgriPro (Exptl.)	60.6	4	99	12,700	22	52.3	33.5
Deliver	Okla. St.	58.5	4	100	17,200	23	54.2	37.2
Longhorn	AgriPro	63.8	4	99	15,400	25	54.2	27.6
Russian (Eldorado)	Richardson	59.6	4	99	12,900	27	54.3	23.9
TAM 109	West Gaines	63.0	4	100	12,100	25	53.0	24.5
TAM 401	Texas AgriLife	60.0	4	99	16,400	23	51.2	27.7
TX03A0148	TX AgriLife (Exptl.)	56.3	4	99	15,600	23	51.3	27.7
"Clearfield" Herbicide Tolerant Wheats								
AP503CL2	AgriPro	59.4	4	99	18,000	22	55.3	35.3
Bond CL	Colo St.	61.1	4	99	11,900	25	53.7	42.4
Okfield (CL)	Okla. St.	59.2	4	94	17,200	25	53.7	27.8
Protection CL	AGSECO	58.9	4	96	18,100	23	51.1	30.9
NK 812 Local Favorite (Southwest South Plains only)								
NK 812 Untreated	CenTex (certified)	62.2	4	94	14,100	22	50.2	27.9
NK 812 Treated	Delman Ellison	58.4	4		16,400	21	50.6	32.7

Trial Averages Listed by variety type (# of varieties)	Seed Test Wt. (lbs./bu)	Visual Seed Rating†	% Germ	Seeds per Lb.	Height (in.)	Harvest Test Wt. (lbs./bu)	Yield Bu/a at 14% H2O
Variety Test Average--Bearded (34)				15,500	22	54.2	38.3
TX AgriLife Recommended Irrigated Bearded Wheats for Grain§					23	54.2	37.8§
Beardless Wheat Average (7)				14,600	24	52.9	28.9
Clearfield Wheat Average (4)				16,300	24	53.4	34.1
NK 812 Average (2)				16,400	21	50.6	32.7
Grand Total Average (47)			**98**	**15,400**	**23**	**53.8**	**36.2**
Protected Least Signif Difference (90%)#					1.8	1.2	6.2
Coefficient of Variation, CV (%)‡					10.0	3.4	26.3‡

Seeding Rate Component

TAM 111, 30 lbs./A	Texas AgriLife	60.2	4		16,000	25	55.0	40.8
TAM 111, 60 lbs./A	Texas AgriLife	"	"		"	25	55.7	40.7
TAM 111, 90 lbs./A	Texas AgriLife	"	"		"	24	56.2	44.0
TAM 111, 120 lbs./A	Texas AgriLife	"	"		"	24	55.5	41.6

†Would Trostle buy this planting seed sample based on visual appearance?
0 = no, 1 = probably not, 2 = maybe, 3 = probably yes, 4 = yes.

§Texas AgriLife recommended varieties for irrigation in the Texas High Plains: TAM 111, TAM 112 (limited irrigation only), TAM 304, Dumas (full irrigation only), Duster, Endurance, Hatcher. The average yield of recommended grain varieties for this trial was pulled down sharply by the underperformance of TAM 304.

#Values in the same column that differ by more than the PLSD are not significantly different.

‡When the coefficient of variation rises above ~15% this indicates substantial variation in the trial results. Therefore, using either absolute values or the statistical parameters to confidently differentiate significant differences between any two varieties is greatly diminished.

TASK 8: INTEGRATED CROP/FORAGE/LIVESTOCK SYSTEMS AND ANIMAL PRODUCTION EVALUATION

Dr. Vivien Allen
Song Cui
Cody Zilverberg

Descriptions of sites that include livestock

Of the 26 sites in the demonstration project in 2009, five included livestock. This compares with six sites in 2008 and 2007, five sites in 2006 and four sites in 2005. The change in cattle numbers across the demonstration project is seen in Figures 11 and 12. While cattle number declined somewhat in 2009 there was only a slight decline in perennial grass acres (Fig. 11)

Four sites within the demonstration project involving livestock in 2009 were beef cow-calf systems with one site using stocker cattle. Cattle in all systems except for system 5 were handled as contract grazing at a fee of $15 per head each month of grazing.

Site 4: This site, previously a cow-calf site, used contract grazing of cows and calves in 2009. Cattle grazed wheat and sorghum residue in Fields 2 and 4. The remaining part of this system included cotton (Field 1) and a new establishment of alfalfa in Field 5.

Site 5. This is a purebred Angus cow-calf system that spends most of its time within the system area. Cattle have generally calved off site on wheat pasture before entering this system. This system does not contain a cropping component but hay is harvested if there is excess forage. Hay (150 bales) was harvested in 2009. The area under the center-pivot is divided into six sections and each year for the last several years, one of these sections has been renovated to improve forage production. In the year of renovation, this section is harvested for hay. This hay is stored and fed for supplemental winter feed to the cow herd. This system is evaluated as an intact grazing system with the off-site grazing for stover or wheat pasture during winter handled as contract grazing. Calves are weaned in early autumn. Steer calves are considered 'sold' by the pound at weaning about October while heifers are kept on-site within the system. Heifers are 'sold' as yearlings at 12 to 15 months as breeding stock 'by the head.' In actual fact, this producer retains steer calves past weaning and though feedlot finishing. These calves graze crop residues and wheat pasture as available until entering the feedlot for finishing. They are sorted into size groups and enter the finishing phase based on their size. Carcass data is collected and selection of cow and bull genetics is targeted to feedlot performance and carcass merit of the calves. The genetics of this herd has been steadily improved over the past years by extensive use of artificial insemination (AI) to known sires for carcass merit improvement. However, for the purposes of calculating economic return to this system for the Demonstration project, these steer calves are considered sold at weaning based on current market prices to approximate the marketing strategies most commonly practiced.

Site 10. This four-field system includes two fields of WW-B. Dahl old world bluestem, one field of bermudagrass and a final field used variously for cropping (cotton in 2009). The system provides a small part of the summer grazing required for registered SimmiAngus and ChiAngus cow-calf herds. Different parts of the herd are moved on and off the system as needed, and it generally provides a place for grazing of pairs and calving of older cows. If grazing is not needed, hay is harvested. Although both hay and a seed crop from the old world bluestem have been harvested in previous years, in 2009 neither hay nor grass seed were harvested. Due to the continual movement of cattle on and off the site, livestock income is calculated as contract grazing based on grazing days. Field 2 is generally intensively cropped, often double-cropped, but is not used for grazing. When planted to forage sorghum and harvested for hay, this field can be used as supplemental winter feed for the cow herd. In 2009, Field 2 was planted to cotton and did not contribute to grazing.

Site 17. This is a cross-bred cow-calf system and is calculated as contract grazing because of movement on and off the system. Cows generally spend the majority of the year on site but in 2009 they occupied this area for only 6 months. Excess forage from WW-B. Dahl on field 1 and 2 is harvested as hay in some years but not in 2009. While both fields have been harvested for seed in past years, only field 1 was harvested for seed in autumn 2009. Fields 1 and 2 provide the majority of the grazing for the cows and calves. These cattle also graze forages off site generally in fall through mid-winter when grazing crop residues. Cattle are supplemented in winter with cotton burrs and hay harvested from the site.

Site 26. Site 26 was a corn, sunflower, and contract grazing system. Cattle (80 head of heifers) grazed winter wheat planted in field 1 during a 4-month period. The remainder of this system was confectionary sunflowers and white food corn.

Several grant proposals were either submitted or are in various stages of preparation. They include:

1. Request for Federal Funding through the Red Book initiatives of CASNR - $5 million. This earmark request titled "Texas High Plains Center for Sustainable AgroEcosystems" was submitted by Senator John Cornyn to the USDA Appropriations Committee. We will hopefully know the outcome by late summer 2010.

2. Submitted proposal to CSREES for 'proof of concept' grant and was funded. This $200,000 grant was one of 3 funded in the U.S. Originally it was to lead to a next level of funding opportunity (10-year; $10 million) and to be designated as a long-term Agroecosystem site. This program was cancelled at the national level, however. In its place, the USDA-NIFA program has now initiated RFAs under 'Climate Change' that will offer opportunities for a proposal to be submitted for 2011.

Song Cui continues work with identifying legumes that have potential for west Texas that would not increase water demands over the associated grasses. His research should be completed by May 2011. Yellow sweetclover and alfalfa appear to have potential in forage/livestock systems and to reduce nitrogen fertilizer requirements.

Cody Zilverberg continues development of methods to assess the energy inputs into forage/livestock systems. Data will be applied to analysis of the Demonstration sites that include cattle.

TASK 9: EQUIPMENT, SITE INSTRUMENTATION, AND DATA COLLECTION FOR WATER MONITORING

Jim Conkwright
Scott Orr
Caleb Jenkins
Gerald Crenwelge

9.1 Equipment Procurement & Installation

Primary System
The following equipment is installed and operating on site:
Electromagnetic flow meters,
Pressure transducers,
NetIrrigate monitoring and control systems
NTE monitoring system is still installed.

Secondary System
The following equipment is operating on site:
Tipping bucket rain gauges,
Temperature Sensors,
HPWD Manual read rain gauges.

Soil Moisture Access Tubes
Neutron probe access sites are located at selected fields on each System. There are a total of 50 moisture probe access tubes. Multiple access tubes are located on some Systems because the Systems have multiple fields with different crops.

System and Field Determination
At the time of planting, all field boundaries are evaluated. Changes in field boundaries are made when needed to accurately identify field boundaries for this crop year. These changes are made, processed, and distributed to the Project.

9.2 Data Collection & Processing

Data collection and site monitoring. Changes in site information consisting of irrigation application method, system parameters, acres, crop, pump plants (size, fuel type, number), are being documented as needed.

Sites equipped with electronic sensors are currently collecting data. Irrigation data is transmitted automatically to the NetIrrigate website.

Soil moisture data is being collected by reading the soil moisture access tubes at crop planting and harvesting on sites that these dates are provided to us. A total of 82 readings were taken during this period.

Water well level recorders at selected sites are logging data on 30 minute intervals and telemetered to HPWD.

Each location equipped with electronic monitoring devices was visited on a regular basis for performance evaluation.

Data Processing. Initial data processing is now automated on the NetIrrigate website for us to download.

Irrigation and rainfall data is processed at the end of the calendar year along with crop ET data where it exists to establish water use efficiency of each crop and crop ET relationships for inclusion into the annual TAWC report at the end of the calendar year.

Summary. The NetIrrigate data telemetry systems are still showing to be superior to the previous data collection system. Additionally, producers can view current water use and historical water use by accessing the NetIrrigate website. Monitoring systems now allow staff to view irrigation data on hourly versus 24 hour intervals.

Cropping pattern changes are monitored closely as field boundary changes necessitate additional Neutron soil moisture access tube installation and fluctuations in crop acreages.

Statement of Factors Affecting Irrigation Water Savings

The district has an excellent long-standing reputation educating constituents on the importance of water conservation. The district has for many years worked with irrigated agriculture by supplying timely information to positively impact the management of water resources. For many years district cooperative projects have involved the measurement of actual on-farm irrigation applications. The resulting water use efficiency (Table 31) and irrigation data are returned to cooperators in order to benefit their water management decisions.

Through many years of experience performing on-farm irrigation audits, the district has determined that there are many factors which affect water use. The district must weigh these factors when accounting for the effectiveness of its own conservation projects. Although not all inclusive, estimated water savings must be tempered with these factors in mind.

The factors have been:

- The ability or inability of producers to supply irrigation water to meet total crop water demand. The majority of producers in this district can only supplement precipitation;
- The fluctuating amount of precipitation received from one growing season to the next;
- The timeliness of precipitation;
- The cost of pumping underground water;
- Water quality which may limit amount of water applied to crops in a few areas;
- Historic and traditional practices which may or may not foster a willingness to accept change;
- Enhanced computerized technology that are available to producers that need to be evaluated for their use;
- Current crop prices and the decision to alter irrigation practices to supply a particular market;
- Consciousness of water conservation while participating in conservation oriented projects;
- Continuing or consistent use of conservation practices after project conclusion and district presence is less frequent.

Table 31. Water use efficiency (WUE) by various cropping and livestock systems in Hale and Floyd Counties (2009).

WATER USE EFFICIENCY															
Year	System	Field	Crop	Application Method	Acres	Inches Soil Moisture at Planting (0-5 ft)	Inches Soil Moisture at Harvest (0-5 ft)	Soil Moisture Contribution to WUE	Acre Inch Irrigation Applied	Growing Season Rain (in)	Effective Rainfall (70% of Actual Rain)	Total Crop Water (Inches per Acre)	Yield (lbs/ac)	Yield Per Acre Inch Of Irrigation (lbs.)	Yield Per Acre Inch Of Total Water (lbs.)
2009	***2***	***1***	Cotton	SDI	60.9	9.83	5.88	3.95	10.50	9.47	6.63	21.08	1021.0	97.24	48.44
2009	***3***	***1***	Milo	MESA	61.5	10.26	3.48	6.78	5.73	8.41	5.89	18.40	6441.0	1,124.08	350.11
2009	***3***	***2***	Cotton	MESA	61.8	8.49	1.69	6.80	6.05	8.41	5.89	18.74	1325.0	219.01	70.72
2009	***4***	***1***	Cotton	LESA	13.3	3.93	2.08	1.85	11.80	12.22	8.55	22.20	925.0	78.39	41.66
2009	***4***	***2***	Wheat	LESA	65.3	3.76	4.88	-1.12	6.30	9.40	6.58	11.76	2160.0	342.86	183.67
2009	***4***	***4***	Sorghum	LESA	28.4	3.76	4.88	-1.12	8.60	13.31	9.32	16.80	7945.0	923.84	473.00
2009	***4***	***5***	Alfalfa	LESA	16	3.76	4.88	-1.12	18.60	14.52	10.16	27.64	19900.0	1,069.89	719.87
2009	***5***	***4***	Grass	MESA	89.2	8.10	1.45	6.65	6.60	15.13	10.59	23.84	N/A	N/A	N/A
2009	***6***	***4***	Cotton	LESA	90.8	8.13	8.21	-0.08	8.35	8.73	6.11	14.38	1220.0	146.11	84.83
2009	***6***	***5***	Corn	LESA	32.1	4.15	4.51	-0.36	16.19	9.69	6.78	22.61	13080.0	807.91	578.43
2009	***7***	***1***	Grass Seed	LESA	130	8.38	8.33	0.05	15.70	10.49	7.34	23.09	484.0	30.83	20.96
2009	***7***	***1***	Hay	LESA	130	8.38	8.33	0.05	15.70	10.49	7.34	23.09	4.5 bales	N/A	N/A
2009	***8***	***1***	Grass Seed	SDI	61.8	8.93	5.67	3.26	13.80	10.49	7.34	24.40	400.0	28.99	16.39
2009	***8***	***1***	Hay	SDI	61.8	8.93	5.67	3.26	13.80	10.49	7.34	24.40	4.5 bales	N/A	N/A
2009	***9***	***2***	Cotton	MESA	137	4.78	3.70	1.08	5.51	8.30	5.81	12.40	885.9	160.78	71.44
2009	***10***	***2***	Cotton	LESA	44.5	7.19	3.11	4.08	10.60	10.60	7.42	22.10	1105.0	104.25	50.00
2009	***11***	***1***	Cotton	Furrow	45.2	7.46	4.64	2.82	11.67	8.42	5.89	20.38	1009.0	86.46	49.50
2009	***11***	***2***	Sorghum	Furrow	24.4	7.46	4.64	2.82	13.79	7.97	5.58	22.19	6275.0	455.04	282.80
2009	***11***	***3***	Cotton	Furrow	22.9	7.46	4.64	2.82	15.76	8.42	5.89	24.47	1157.0	73.41	47.27
2009	***14***	***2***	Cotton	MESA	61.8	5.92	1.45	4.47	12.03	6.26	4.38	20.88	1301.0	108.17	62.31
2009	***15***	***5***	Cotton	SDI	18.8	8.83	3.65	5.18	21.00	7.08	4.96	31.14	1841.0	87.67	59.13
2009	***15***	***7***	Cotton	N/A	26.8	9.11	1.82	7.29	N/A	7.08	4.96	12.25	691.0	N/A	56.43
2009	***17***	***1***	Grass	MESA	53.6	7.28	1.80	5.48	8.52	13.34	9.34	23.34	N/A	N/A	N/A
2009	***17***	***2***	Grass	MESA	58.3	7.28	1.80	5.48	9.37	13.34	9.34	24.19	N/A	N/A	N/A
2009	***17***	***3***	Sunflowers	MESA	108.9	8.82	8.95	-0.13	5.16	11.31	7.92	12.95	2960.0	573.64	228.62
2009	***18***	***1***	Cotton	MESA	60.7	7.37	2.26	5.11	5.73	12.31	8.62	19.46	1182.0	206.28	60.75
2009	***18***	***2***	Wheat	MESA	61.5	7.70	3.56	4.14	1.36	9.44	6.61	12.11	1440.0	1,058.82	118.93
2009	***19***	***10***	Cotton	LEPA	60.1	8.70	6.06	2.64	7.11	7.49	5.24	14.99	953.0	134.04	63.56
2009	***20***	***1***	Cotton	LEPA	117.6	8.12	9.04	-0.92	23.20	12.67	8.87	31.15	1965.0	84.70	63.08
2009	***20***	***2***	Corn Silage	LEPA	115.7	8.12	9.04	-0.92	24.25	9.16	6.41	29.74	56600.0	2,334.02	1,903.03
2009	***21***	***1***	Grass Hay	LEPA	61.4	7.08	2.28	4.80	16.50	11.92	8.34	29.64	4900.0	296.97	165.29
2009	***21***	***1***	Seed	LEPA	61.4	7.08	2.28	4.80	16.50	11.92	8.34	29.64	202.0	12.24	6.81
2009	***21***	***2***	Wheat/Hay	LEPA	61.2	7.03	2.75	4.28	8.24	4.93	3.45	15.97	6.2 bales	N/A	N/A
2009	***22***	***3***	Cotton	LEPA	148.7	8.74	8.81	-0.07	14.37	10.21	7.15	21.45	1438.0	100.05	67.04
2009	***23***	***5***	Silage	LESA	60.5	6.52	7.61	-1.09	15.67	8.72	6.10	20.68	37500.0	2,393.11	1,813.00
2009	***24***	***1***	Corn	LESA	64.6	7.96	7.28	0.68	18.80	12.52	8.76	28.24	12300.0	654.26	435.49
2009	***24***	***2***	Sunflowers	LESA	65.1	10.43	7.73	2.70	7.43	11.64	8.15	18.28	1860.0	250.34	101.76
2009	***26***	***1***	Sunflowers	LESA	62.9	7.12	3.96	3.16	13.82	11.72	8.20	25.18	2476.0	179.16	98.32
2009	***26***	***2***	Corn	LESA	62.3	8.05	2.57	5.48	16.18	11.91	8.34	30.00	13440.0	830.66	448.04
2009	***27***	***1***	Corn	SDI	46.2	9.30	4.81	4.49	28.00	12.32	8.62	41.11	15420.0	550.71	375.05
2009	***27***	***3***	Cotton	SDI	48.8	10.02	2.62	7.40	18.20	11.82	8.27	33.87	1723.0	94.67	50.86
2009	***28***	***1***	Cotton	SDI	51.5	9.40	1.01	8.39	10.89	11.88	8.32	27.59	1477.0	135.66	53.53
2009	***30***	***1***	Sunflowers	SDI	50.8	9.23	4.95	4.28	9.25	11.72	8.20	21.73	1800.0	194.59	82.82

Water Use Efficiency Synopsis Task 9 Year 5

The total crop water demand decreased significantly compared to 2008. The Irrigation Efficiency Summary table (Table 32) shows that the theoretical total water conservation savings in 2009 was higher than 2008 (2,133 vs. 65 acre feet; see 4th Annual Report, 2008, Table 26). The Total Water Efficiency Summary table (Table 33) shows that the theoretical total irrigation conservation in 2009 was also greater than 2008. The exact reasons are not known but part is due to the significant reduction in corn acres in 2009. It may also be due to better equipment to monitor water use and rainfall in 2009. This project has also made producers much more aware of water use and given them the tools to see how much water is being used throughout the crop season.

Year 5 of the demonstration project had below average rainfall. The average rainfall in 2008 in the project was 21.6 inches while it was 15.2 inches in 2009. However, the consensus was that the rainfall did occur in a timely manner for crop production in 2009. May, September, and October of 2008 averaged over 4.4 of rainfall each month. In 2009, the month with the most rain occurred in June with an average of 3.5 inches. July of 2009 averaged 2.5 inches but all the other months had less than 2 inches of rainfall. Even with less rainfall in 2009, the irrigation water use was significantly less than 2008, as stated earlier.

Precipitation timing is but one factor which affected irrigation application totals for 2009. The data shows that the average amount of irrigation water applied per application increased slightly in 2009 when compared to 2008. The main factor was probably the reduced rainfall. The data also shows that there were more double cropped fields in 2009 which should have significantly increased water use in the project because water was applied to the same field for two crops in one year.

Better equipment will be installed in the spring of 2010 to capture more complete data. This improvement should also transfer to the producer so they can have better irrigation information on hand to further optimize scheduling of irrigation amounts and timing of irrigation events.

Table 32. Irrigation efficiency summary by various cropping and livestock systems in Hale and Floyd Counties (2009).

			IRRIGATION EFFICIENCY SUMMARY									
Year	**System**	**Field**	**Crop**	**Application Method**	**Acres**	**Acre Inch Irrigation Applied**	**Total Crop Water (Inches per Acre)**	**ET Crop Water Demand (inches per acre)**	**ET Provided to Crop From Irrigation (%)**	**Potential Irrigation Conserved (%)**	**Potential Irrigation Conserved (Inches per acre)**	**Total Irrigation Potentially Conserved (ac ft)**
2009	2	1	Cotton	SDI	60.9	10.50	21.08	27.88	37.66%	62.34%	17.38	88.20
2009	3	1	Milo	MESA	61.5	5.73	18.40	25.54	22.44%	77.56%	19.81	101.53
2009	3	2	Cotton	MESA	61.8	6.05	18.74	27.64	21.89%	78.11%	21.59	111.19
2009	4	1	Cotton	LESA	13.3	11.80	22.20	28.39	41.56%	58.44%	16.59	18.39
2009	4	2	Wheat	LESA	65.3	6.30	11.76	26.76	23.54%	76.46%	20.46	111.34
2009	4	4	Sorghum	LESA	28.4	8.60	16.80	25.54	33.67%	66.33%	16.94	40.09
2009	4	5	Alfalfa	LESA	16	18.60	27.64	N/A	N/A	N/A	N/A	N/A
2009	5	4	Grass	MESA	89.2	6.60	23.84	N/A	N/A	N/A	N/A	N/A
2009	6	4	Cotton	LESA	90.8	8.35	14.38	27.9	29.93%	70.07%	19.55	147.93
2009	6	5	Corn	LESA	32.1	16.19	22.61	29.95	54.06%	45.94%	13.76	36.81
2009	7	1	Grass Seed	LESA	130	15.70	23.09	N/A	N/A	N/A	N/A	N/A
2009	7	1	Hay	LESA	130	15.70	23.09	N/A	N/A	N/A	N/A	N/A
2009	8	1	Grass Seed	SDI	61.8	13.80	24.40	N/A	N/A	N/A	N/A	N/A
2009	8	1	Hay	SDI	61.8	13.80	24.40	N/A	N/A	N/A	N/A	N/A
2009	9	2	Cotton	MESA	137	5.51	12.40	28.87	19.09%	80.91%	23.36	266.69
2009	10	2	Cotton	LESA	44.5	10.60	22.10	27.69	38.28%	61.72%	17.09	63.38
2009	11	1	Cotton	Furrow	45.2	11.67	20.38	29.36	39.75%	60.25%	17.69	66.63
2009	11	2	Sorghum	Furrow	24.4	13.79	22.19	24.7	55.83%	44.17%	10.91	22.18
2009	11	3	Cotton	Furrow	22.9	15.76	24.47	29.36	53.68%	46.32%	13.60	25.95
2009	14	2	Cotton	MESA	61.8	12.03	20.88	28	42.96%	57.04%	15.97	82.26
2009	15	5	Cotton	SDI	18.8	21.00	31.14	26.73	78.56%	21.44%	5.73	8.98
2009	15	7	Cotton	N/A	26.8	N/A	12.25	26.73	N/A	N/A	N/A	N/A
2009	17	1	Grass	MESA	53.6	8.52	23.34	N/A	N/A	N/A	N/A	N/A
2009	17	2	Grass	MESA	58.3	9.37	24.19	N/A	N/A	N/A	N/A	N/A
2009	17	3	Sunflowers	MESA	108.9	5.16	12.95	N/A	N/A	N/A	N/A	N/A
2009	18	1	Cotton	MESA	60.7	5.73	19.46	N/A	N/A	N/A	N/A	N/A
2009	18	2	Wheat	MESA	61.5	1.36	12.11	26.45	5.14%	94.86%	25.09	128.59
2009	19	10	Cotton	LEPA	60.1	7.11	14.99	28.48	24.96%	75.04%	21.37	107.03
2009	20	1	Cotton	LEPA	117.6	23.20	31.15	28.84	80.44%	19.56%	5.64	55.27
2009	20	2	Corn Silage	LEPA	115.7	24.25	29.74	26.16	92.70%	7.30%	1.91	18.42
2009	21	1	Grass Hay	LEPA	61.4	16.50	29.64	N/A	N/A	N/A	N/A	N/A
2009	21	1	Seed	LEPA	61.4	16.50	29.64	N/A	N/A	N/A	N/A	N/A
2009	21	2	Wheat/Hay	LEPA	61.2	8.24	15.97	24.1	34.19%	65.81%	15.86	80.89
2009	22	3	Cotton	LEPA	148.7	14.37	21.45	27.32	52.61%	47.39%	12.95	160.44
2009	23	5	Silage	LESA	60.5	15.67	20.68	25.56	61.31%	38.69%	9.89	49.86
2009	24	1	Corn	LESA	64.6	18.80	28.24	30.17	62.31%	37.69%	11.37	61.21
2009	24	2	Sunflowers	LESA	65.1	7.43	18.28	N/A	N/A	N/A	N/A	N/A
2009	26	1	Sunflowers	LESA	62.9	13.82	25.18	N/A	N/A	N/A	N/A	N/A
2009	26	2	Corn	LESA	62.3	16.18	30.00	30.76	52.60%	47.40%	14.58	75.69
2009	27	1	Corn	SDI	46.2	28.00	41.11	32.11	87.20%	12.80%	4.11	15.82
2009	27	3	Cotton	SDI	48.8	18.20	33.87	27.59	65.97%	34.03%	9.39	38.19
2009	28	1	Cotton	SDI	51.5	10.89	27.59	27.69	39.32%	60.68%	16.80	72.11
2009	30	1	Sunflowers	SDI	50.8	9.25	21.73	27.69	33.41%	66.59%	18.44	78.06

Table 33. Total water efficiency summary by various cropping and livestock systems in Hale and Floyd Counties (2009).

				TOTAL WATER EFFICIENCY SUMMARY								
Year	System	Field	Crop	Application Method	Acres	Irrigation Applied (Inches per acre)	Total Crop Water (Inches per Acre)	ET Crop Water Demand (Inches per acre)	Total Water Potential Used (%)	Total Water Potential Water Demand Conserved (%)	Total Water Potential Use (inches per acre)	Total Irrigation Potentially Conserved (ac ft)
2009	2	1	Cotton	SDI	60.9	10.50	21.08	27.88	75.61%	24.39%	6.80	34.52
2009	3	1	Milo	MESA	61.5	5.73	18.40	25.54	72.03%	27.97%	7.14	36.61
2009	3	2	Cotton	MESA	61.8	6.05	18.74	27.64	67.79%	32.21%	8.90	45.85
2009	4	1	Cotton	LESA	13.3	11.80	22.20	28.39	78.21%	21.79%	6.19	6.86
2009	4	2	Wheat	LESA	65.3	6.30	11.76	26.76	43.95%	56.05%	15.00	81.63
2009	4	4	Sorghum	LESA	28.4	8.60	16.80	25.54	65.77%	34.23%	8.74	20.69
2009	4	5	Alfalfa	LESA	16	18.60	27.64	N/A	N/A	N/A	N/A	N/A
2009	5	4	Grass	MESA	89.2	6.60	23.84	N/A	N/A	N/A	N/A	N/A
2009	6	4	Cotton	LESA	90.8	8.35	14.38	27.9	51.54%	48.46%	13.52	102.29
2009	6	5	Corn	LESA	32.1	16.19	22.61	29.95	75.50%	24.50%	7.34	19.63
2009	7	1	Grass Seed	LESA	130	15.70	23.09	N/A	N/A	N/A	N/A	N/A
2009	7	1	Hay	LESA	130	15.70	23.09	N/A	N/A	N/A	N/A	N/A
2009	8	1	Grass Seed	SDI	61.8	13.80	24.40	N/A	N/A	N/A	N/A	N/A
2009	8	1	Hay	SDI	61.8	13.80	24.40	N/A	N/A	N/A	N/A	N/A
2009	9	2	Cotton	MESA	137	5.51	12.40	28.87	42.95%	57.05%	16.47	188.03
2009	10	2	Cotton	LESA	44.5	10.60	22.10	27.69	79.81%	20.19%	5.59	20.73
2009	11	1	Cotton	Furrow	45.2	11.67	20.38	29.36	69.43%	30.57%	8.98	33.81
2009	11	2	Sorghum	Furrow	24.4	13.79	22.19	24.7	89.83%	10.17%	2.51	5.11
2009	11	3	Cotton	Furrow	22.9	15.76	24.47	29.36	83.36%	16.64%	4.89	9.32
2009	14	2	Cotton	MESA	61.8	12.03	20.88	28	74.57%	25.43%	7.12	36.67
2009	15	5	Cotton	SDI	18.8	21.00	31.14	26.73	116.48%	-16.48%	-4.41	-6.90
2009	15	7	Cotton	N/A	26.8	N/A	12.25	26.73	45.81%	54.19%	14.48	32.35
2009	17	1	Grass	MESA	53.6	8.52	23.34	N/A	N/A	N/A	N/A	N/A
2009	17	2	Grass	MESA	58.3	9.37	24.19	N/A	N/A	N/A	N/A	N/A
2009	17	3	Sunflowers	MESA	108.9	5.16	12.95	N/A	N/A	N/A	N/A	N/A
2009	18	1	Cotton	MESA	60.7	5.73	19.46	N/A	N/A	N/A	N/A	N/A
2009	18	2	Wheat	MESA	61.5	1.36	12.11	26.45	45.78%	54.22%	14.34	73.50
2009	19	10	Cotton	LEPA	60.1	7.11	14.99	28.48	52.64%	47.36%	13.49	67.55
2009	20	1	Cotton	LEPA	117.6	23.20	31.15	28.84	108.01%	-8.01%	-2.31	-22.63
2009	20	2	Corn Silage	LEPA	115.7	24.25	29.74	26.16	113.69%	-13.69%	-3.58	-34.54
2009	21	1	Grass Hay	LEPA	61.4	16.50	29.64	N/A	N/A	N/A	N/A	N/A
2009	21	1	Seed	LEPA	61.4	16.50	29.64	N/A	N/A	N/A	N/A	N/A
2009	21	2	Wheat/Hay	LEPA	61.2	8.24	15.97	N/A	N/A	N/A	N/A	N/A
2009	22	3	Cotton	LEPA	148.7	14.37	21.45	27.32	78.51%	21.49%	5.87	72.74
2009	23	5	Silage	LESA	60.5	15.67	20.68	N/A	N/A	N/A	N/A	N/A
2009	24	1	Corn	LESA	64.6	18.80	28.24	30.17	93.62%	6.38%	1.93	10.37
2009	24	2	Sunflowers	LESA	65.1	7.43	18.28	N/A	N/A	N/A	N/A	N/A
2009	26	1	Sunflowers	LESA	62.9	13.82	25.18	N/A	N/A	N/A	N/A	N/A
2009	26	2	Corn	LESA	62.3	16.18	30.00	30.76	97.52%	2.48%	0.76	3.96
2009	27	1	Corn	SDI	46.2	28.00	41.11	32.11	128.04%	-28.04%	-9.00	-34.67
2009	27	3	Cotton	SDI	48.8	18.20	33.87	27.59	122.78%	-22.78%	-6.28	-25.55
2009	28	1	Cotton	SDI	51.5	10.89	27.59	27.69	99.65%	0.35%	0.10	0.41
2009	30	1	Sunflowers	SDI	50.8	9.25	21.73	27.69	78.49%	21.51%	5.96	25.21

BUDGET

Table 34. Task and expense budget for years 1-5 of the demonstration project.

2005-358-014 **Task Budget**	**Task Budget**	**Year 1** (9/22/04 - 1/31/06) *revised*	**Year 2** (2/01/06 - 2/28/07) *revised*	**Year 3** (3/01/07 - 2/29/08)	**Year 4** (3/01/08 - 2/28/09)	**Year 5** (03/01/09 - 2/28/10)
1	5,450	4,537	0	0	0	0
2	2,667,550	216,608	335,702	317,317	299,727	249,163
3	675,402	21,112	33,833	80,984	61,455	56,239
4	610,565	52,409	40,940	46,329	53,602	64,124
5	371,359	42,428	40,534	47,506	38,721	51,158
6	633,173	54,531	75,387	71,106	60,257	39,595
7	306,020	37,014	22,801	30,516	25,841	11,497
8	334,692	44,629	43,063	41,243	43,927	42,084
9	620,564	145,078	39,011	35,656	82,844	52,423
TOTAL	6,224,775	618,345	631,271	670,657	666,374	566,283

Expense Budget	**Total Budget**	**Year 1** (09/22/04 - 01/31/06)	**Year 2** (02/01/06 - 02/28/07)	**Year 3** (3/01/07 - 2/29/08)	**Year 4** (3/01/08 - 2/28/09)	**Year 5** (03/01/09 - 2/28/10)
Salary and Wages [1]	2,126,070	230,131	300,531	298,106	296,944	259,004
Fringe[2] (20% of Salary)	288,370	29,304	35,534	37,265	42,029	38,105
Insurance	312,512	13,318	26,529	25,302	25,942	21,508
Tuition and Fees	200,522	8,127	16,393	21,679	18,502	13,277
Travel	150,987	14,508	24,392	14,650	15,556	16,579
Capital Equipment	76,555	22,554	13,393	448	707	19,958
Expendable Supplies	381,046	14,803	16,100	12,205	18,288	8,614
Subcon	1,741,376	212,360	103,389	161,540	183,125	131,627
Technical/Computer	190,400	9,740	3,879	16,225	430	6,700
Communications	365,000	25,339	45,040	38,801	26,361	14,448
Reproduction (incl under comm)						
Vehicle Insurance	5,000	0	397	235	187	194
Overhead	386,938	38,160	45,694	44,202	38,302	36,270
Profit						
TOTAL	6,224,775	618,345	631,271	670,657	666,374	566,283

COST SHARING

Table 35. Cost share figures for TTU, AgriLife (TAMU) and HPUWCD for years 1-5 of the demonstration project.

Cost Sharing Balance Summary

Budget	**Total Cost Share Budgeted**	***Actual Funds Contributed***	***Balance***
TTU		577,476.73	
TAMU		208,203.74	
HPUWCD		137,813.56	
TOTAL	1,312,000.00	923,494.03	388,505.97

Task Categories	**Total Task Budget**	***Actual Funds Contributed***	***Balance***
Task 1 - TTU		-	
Task 2 - TTU		369,785.89	
Task 3 - TAMU		185,529.77	
Task 4 - TTU		5,798.07	
Task 5 - TTU		6,389.40	
Task 6 - TTU		124,232.96	
Task 7 - TAMU		22,673.96	
Task 8 - TTU		71,270.41	
Task 9 - HPUWCD		137,813.57	
TOTAL	1,312,000.00	923,494.03	388,505.97

Expense Categories	**Total Expense Budget**	***Actual Funds Contributed***	***Balance***
Salary & Wages		156,411.42	
Fringe		45,639.16	
Overhead		375,426.15	
SubCon - TAMU		208,203.74	
$25,000/year - HPUWCD		137,813.56	
TOTAL	1,312,000.00	923,494.03	388,505.97

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