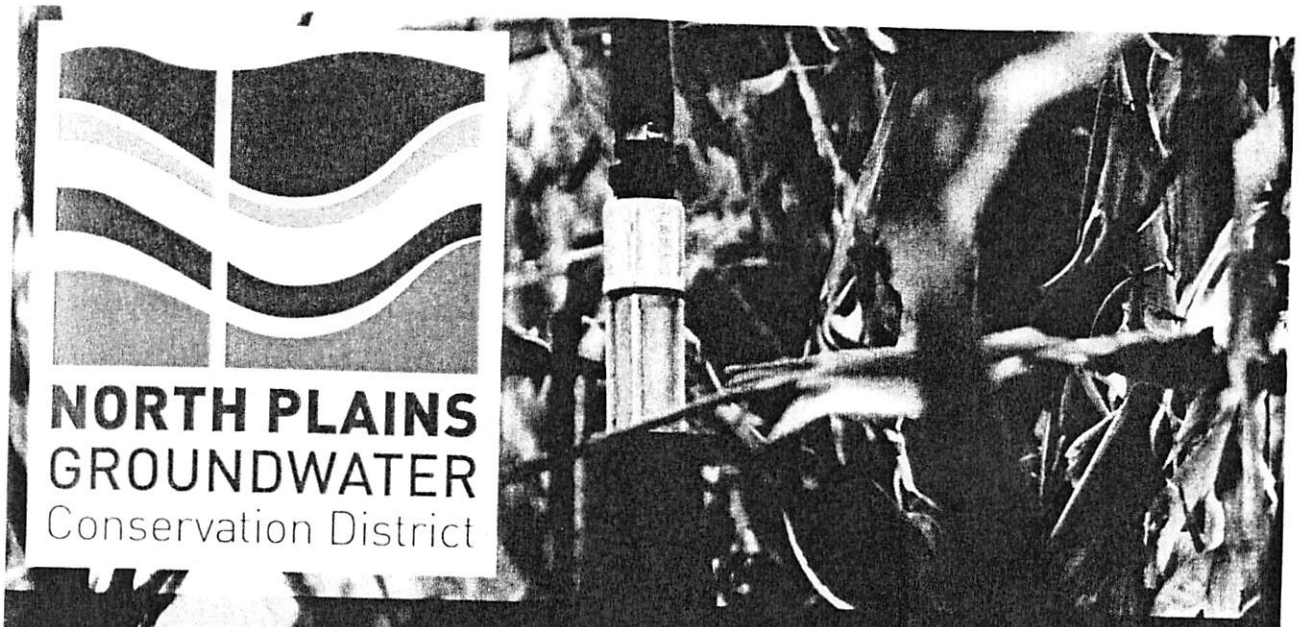
NORTH PLAINS
GROUNDWATER
Conservation District



2011-12 Reduced Irrigation on Corn Demonstration Project

Final Report for TWDB Contract #1103581252

Principal Participants:

Danny Krienke, NPGCD Director - Ochiltree County Cooperator (2010-2013)
Harold Grall, NPGCD Director - Moore County Cooperator (2010-2013)
Phil Haaland, Past NPGCD Director - Hartley County Cooperator (2010-2013)
Brian Bezner, Past NPGCD Director - Dallam County Cooperator (2011-2013)
James Born - Ochiltree County Cooperator (2011)
Brent Clark - Hartley County Cooperator (2012-2013)
David Ford - Hartley County Cooperator (2012-2013)
Frische Brothers - Moore County Cooperator (2012-2013)
Hartley Feeders - Hartley County Cooperator (2011-2013)
Chad Hicks - Hartley County Cooperator (2011-2012)
Tommy Laubhan - Lipscomb County Cooperator (2012-2013)
Joe Reinart - Sherman County Cooperator (2011-2013)
Richard Schad - Hansford County Cooperator (2012-2013)
Steve Shields - Hutchinson County Cooperator (2011)

Principal Staff:

Steven D. Walthour, P.G., General Manager
Leon New, P.E., District Conservationist
Paul M. Sigle, E.I.T., Agricultural Engineer
Randy Coon, Natural Resource Specialist
Kari Bryant, Agricultural Demonstration and Research Specialist

Acknowledgments:

David Reinart, Better Harvest Inc.
David Sloane, AquaSpy Inc.
Barrett Mooney, HydroBio ARS
Karlyle Haaland, PivoTrac
North Plains Groundwater Conservation District's Board of Directors
USDA-NRCS Conservation Innovation Grant
TWDB Agricultural Water Conservation Grant

Tal

List

List o

NORTH PLAINS GROUNDWATER Conservation District

200-12 Reduced Irrigation on Corn Demonstration Project

Final Report for TWDB Contract #1103581252

Principal Participants:

Danny Krienke, NPGCD Director - Ochiltree County Cooperator (2010-2013)
Harold Grall, NPGCD Director - Moore County Cooperator (2010-2013)
Phil Haaland, Past NPGCD Director - Hartley County Cooperator (2010-2013)
Brian Bezner, Past NPGCD Director - Dallam County Cooperator (2011-2013)
James Born - Ochiltree County Cooperator (2011)
Brent Clark - Hartley County Cooperator (2012-2013)
David Ford - Hartley County Cooperator (2012-2013)
Frische Brothers - Moore County Cooperator (2012-2013)
Hartley Feeders - Hartley County Cooperator (2011-2013)
Chad Hicks - Hartley County Cooperator (2011-2012)
Tommy Laubhan - Lipscomb County Cooperator (2012-2013)
Joe Reinart - Sherman County Cooperator (2011-2013)
Richard Schad - Hansford County Cooperator (2012-2013)
Steve Shields - Hutchinson County Cooperator (2011)

Principal Staff:

Steven D. Walthour, P.G., General Manager
Leon New, P.E., District Conservationist
Paul M. Sigle, E.I.T., Agricultural Engineer
Randy Coon, Natural Resource Specialist
Kari Bryant, Agricultural Demonstration and Research Specialist

Acknowledgments:

David Reinart, Better Harvest Inc.
David Sloane, AquaSpy Inc.
Barrett Mooney, HydroBio ARS
Karlyle Haaland, PivoTrac
North Plains Groundwater Conservation District's Board of Directors
USDA-NRCS Conservation Innovation Grant
TWDB Agricultural Water Conservation Grant

Table of Contents

List of Tables

List of Figures

Definition of Terms

AgriPartner was a 10 year (1998-2007) demonstration project conducted by Texas A&M AgriLife Extension.

Application Rate is the amount of water a center pivot system applied during a single revelation, unites: inches pre revelation.

Capacitance is the ability of a body to store an electrical charge.

Electrical Conductivity is the degree to which a specified material conducts electricity.

Electromagnetic is the ability to produce magnetism developed by a current of electricity.

Field Capacity is the amount of water a soil type can hold after excess water has drained.

Harvest is the point where the grain is removed from the plant.

LEPA is low energy precise application used in center pivots.

Net Gain represents the "200-12" field's net profit is higher than the Control field's net profit.

Net Loss represents the "200-12" field's net profit is less than the Control field's net profit.

Pre Plant is the time before planting of the crop.

Root Zone is the area occupied by the crop's roots.

Strip Till is a minimum tillage system that combines the drying and warming benefits of conventional tillage with the soil protecting advantages of no-till by disturbing only the portion of the soil that is to contain the seed row.

Tassel is the last stage in the vegetation growth of a corn plant.

Time Running Wet is the amount of time a center pivot system is applying water.

Variable Rate Irrigation is the process of changing the application rate to supply water at rates relative to the needs of individual areas within the fields.

4 Leaf is the sixth stage in the vegetation growth of a corn plant. The collar of the 4^{th} leaf is visible.

Executive Summary

In 2009, the North Plains Groundwater Conservation District (NPGCD) began planning the "200-12" Reduced Irrigation on Corn Demonstration Project ("200-12" Project). The "200-12" Project is a five year on-farm, field scale project that demonstrates how water conservation technologies and irrigation management practices can reduce groundwater use and still ensure that agricultural producers remain financially viable with restricted and/or diminishing groundwater resources. The "200-12" Project is spearheaded by cooperating growers dedicated to implementing water conservation technologies and practices with a goal of growing 200 bushels of corn utilizing only 12 inches of irrigation water per crop acre. The district's Board of Directors established the 12 inch goal based on an estimated corn crop need of 26 inches of water. Those 26 inches of water includes six inches of soil water, eight inches of rainfall and 12 inches of irrigation water applied to the crop during the growing season. When compared to Texas A&M AgriLife Extension's AgriPartner field demonstration program that averaged 21 inches of irrigation water over 10 years, the "200-12" Project demonstrates the next level of water conservation strategies necessary for irrigation producers to stay financially viable into the future.

During the first year of the "200-12" Project (2010), three district directors, Harold Grall, Danny Krienke and Phil Haaland, dedicated personal irrigated farmland acres to the "200-12" Project. The cooperators implemented new and proven irrigation management technologies and practices to aid in the strategic management of each reduced irrigation water demonstration site. The first year of the project proved a success with the three participants producing an average of 89 percent of their normal yields with an average saving of 9 inches of irrigation water.

In 2011, six additional participants, Hartley Feeders (Dennis Buss), Chad Hicks, Joe Reinart, James Born, Steve Shields, and Brian Bezner joined the project and implemented the project's strategic management practices. While 2010 had been a year of above average rainfall 2011 saw rainfall well below average. That lack of critical rainfall indicated early on that the 12 inches of irrigation water goal was not likely to be achievable; however one field project came close. Due to extreme drought, six participants were forced to divert project water to other fields to prevent devastating financial loss.

In 2012, Brent Clark, David Ford, Frische Brothers, Richard Schad and Tommy Laubhan joined the project while James Born and Steve Shields chose not to participate. Each 2012 participant committed two fields to the project, one called the "200-12" field, the other the Control field. Overall, 2012 was better than 2011 for rainfall, but beginning soil water and seasonal rainfall was still below normal and did limit production to less than expected and needed. High temperatures during the last two weeks in July and the first week in August (and no rain) created a need for more irrigation water. Also six fields did receive hail damage that reduced the harvest yields. Due to the lack of supplemental rainfall, one participant was forced to divert water to

other fields to prevent a devastating financial loss. Another participant harvested silage to prevent total loss of the crop.

In 2013, Chad Hicks did not participate in the program resulting in eleven cooperating producers in the project. Together these cooperators dedicated twenty-two demonstration fields encompassing 1672 acres. 2013 proved to be a better project year and all acres dedicated to the project were harvested for grain. The eleven "200-12" fields' yields averaged 200 bushels per acre and production averaged 11.17 bushels (625 lbs) per inch of irrigation water. Net return per inch of irrigation water averaged $33.73 for the "200-12" fields compared to $30.09 for the Control fields.

What We Learned

- Low energy precise application (LEPA) assisted in boosting yields verses other application types.
- Later planting dates can reduce irrigation requirements due to increased time to receive rainfall.
- Drought tolerant hybrids boosted yields in limited water situations.
- Crop residue is essential to reduce water evaporation, increase water infiltration, and reduce wind erosion.
- Growers must be conscious of the amount of irrigation applied to produce a certain yield, managing on a yield per inch of water basis.
- More knowledge of pre-season and seasonal soil moisture levels will assist in the conservation of water.
- Satellite crop imagery has potential as an additional management tool, but needs further development.

Over the course of the project, irrigation was reduced by 1,286.89 acre-feet (6.29 inches). If six inches of irrigation was reduced over the one million acres of irrigated cropland within the district, it is possible to save up to 500,000 acre-feet of groundwater per year and prolong the viability of irrigated agriculture in the area. 500,000 acre-feet would supply five years of water for the City of Austin. 2014 will be the final year for the "200-12" Project. The district will expand on the "200-12" project, using the project ideology on other crops produced in the area. Table 1 summarizes the water savings of the project.

Table 1: Total Water Savings

Year	Acreage	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)
2010	270	11.30	254.20	7.89	177.50
2011 (1)	682	15.33	871.19	9.24	525.25
2012 (2)	819	16.02	1093.25	5.93	404.51
2013	686	18.08	1033.30	3.14	179.63
Total	**2457**	**15.88**	**3251.94**	**6.29**	**1286.89**

Notes: (1) In 2011, 3 of 9 producers harvested grain, 3 harvested silage, and 3 abandoned their field
(2) In 2012, 1 of 12 producers harvested silage

Introduction

In 2009, the district began planning a demonstration project, dubbed the "200-12 Project," that would use the latest water conservation technologies and practices to grow 200 bushels of corn on 12 inches of irrigation water per acre. The project is based on 12 inches of irrigation, 8 inches of seasonal rainfall and 6 inches of available soil water, to establish 26 inches of total water as guidelines for achieving the goal. The district acknowledges adjustments may be necessary when rainfall and/or soil water are less than the guidelines call for. Corn irrigation averaged 21 inches per acre, while irrigation, rainfall and net soil water averaged 31 inches over the 10 year AgriPartner field demonstration project conducted by Texas A&M AgriLife Extension from 1998-2007. The AgriPartner project included 129 field scale corn demonstrations on 18,815 acres with approximately 150 cooperating growers over the ten year period.

The "200-12" Project demonstrates how water conservation technologies and irrigation management practices can reduce groundwater use and allow agricultural producers to remain financially viable with restricted and diminishing groundwater resources. The "200-12" Project is designed as a five year initiative that provides field-scale profitability and feasibility demonstrations of producing 200 bushels of corn utilizing 12 inches of irrigation water combined with seasonal rainfall and available water within the crop's root zone.

Cooperators

Over the first four years, fourteen cooperating producers dedicated 2,457 irrigated acres to the project. Figure 1 is a map of the locations of each "200-12" participants.

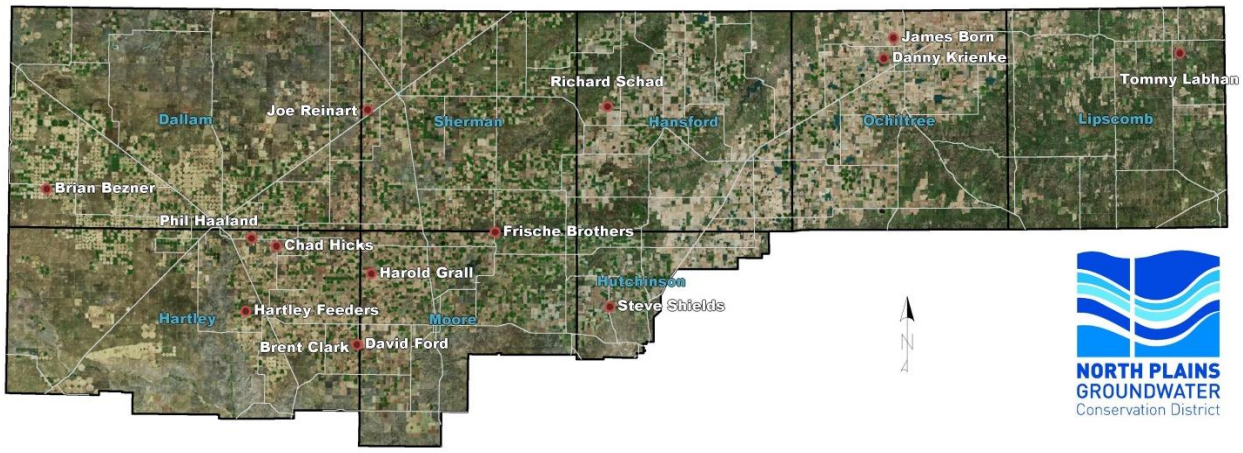


Figure 1: "200-12" Participants' Locations

Board of Directors

Danny Krienke has been involved in Panhandle water issues for over 38 years. A third-generation farmer in the Texas High Plains, Mr. Krienke is the sectary of the Board of Directors for North Plains Groundwater Conservation District. As the chairman of the district's agriculture

committee, Mr. Krienke was one of the founders and original cooperators in the "200-12" Project. Mr. Krienke also serves as a member of Texas Regional Water Planning Group A and is the past chairman of Groundwater Management Area 1. Mr. Krienke represents Ochiltree County, where his family has farmed since his grandfather purchased the land in 1923. He's spent 38 years as a farmer, using both irrigated and dry land techniques and 10 years as a staff member of the Texas A&M Extension Service's Whole Field Irrigation Farm Demonstration Program.

Figure 2: North Plains Groundwater Conservation District's Board of Directors member's participating in the "200-12" Project, *from left to right, Phil Haaland, Harold Grall, Brian Bezner, and Danny Krienke.*

Harold Grall came to the Texas Panhandle in the mid 70's to attend college and pursue a career path in the agribusiness sector of farming. He graduated from West Texas State University with a degree in agricultural economics and moved to Moore County to begin his mentorship with one of the area's premier farming operations owned and operated by Dale and Joan Coleman. After almost a decade later under his mentor's leadership, Mr. Grall moved into a large farming operation in his own right. He was elected to the North Plains Groundwater Conservation District's Board of Directors as the Moore County representative in 2008, currently holding the position of Vice President. Under Mr. Coleman's direction, and based on his own convictions, Mr. Grall developed a farm management philosophy centered on maximizing efficiency of all resources. As a member of the district's agriculture committee, Mr. Grall was one of the founders and original cooperators in the "200-12" Project. Dale Coleman said it best when he was quoted in an interview for Progressive Farmer Magazine: "Harold Grall is the best crop I ever raised."

Phil Haaland served as the Hartley County Director on the North Plains Groundwater Conservation District's Board of Directors until May 10, 2014. Mr. Haaland is a Past President of the board and served on the board for 21 years. As a member of the district's agriculture committee, Mr. Haaland was one of the founders and original cooperators in the "200-12" Project. Mr. Haaland has been involved with agriculture all of his life, with 49 years of farming experience, 15 in Minnesota and the other 34 in the Texas Panhandle. Mr. Haaland has also been a Pioneer seed dealer since moving to Texas in 1979.

Brian Bezner served as the Dallam County Director on the North Plains Groundwater Conservation District's Board of Directors until May 10, 2014, last serving as the Vice President. He joined the three other board members in the "200-12" Project in 2011.

Producers

James Born of Ochiltree County participated in the "200-12" Project in 2011 only, dedicating 115 acres.

Brent Clark of Hartley County joined the "200-12" project in 2012. He dedicated 484 acres over the 2 years he participated in the project.

David Ford of Hartley County joined the "200-12" Project in 2012. He dedicated 240 acres over the 2 years he participated in the project.

Frische Brothers of Moore County joined the "200-12" Project in 2012. He dedicated 214 acres over the 2 years he participated in the project.

Hartley Feeders (Dennis Buss) of Hartley County joined the "200-12" Project in 2011. He dedicated 362 acres over the 3 years he participated in the project.

Chad Hicks and 14 Mile Ranch of Hartley County joined the "200-12" Project in 2011, and participating in 2012. He dedicated 410 acres over the 2 years he participated in the project.

Tommy Laubhan of Lipscomb County joined the "200-12" Project in 2012. He dedicated 244 acres over the 2 years he participated in the project.

Joe Reinart of Sherman County joined the "200-12" Project in 2011. He dedicated 302 acres over the 3 years he participated in the project.

Richard Schad of Hansford County joined in the "200-12" Project in 2012. He dedicated 329 acres over the 2 years he participated in the project.

Steve Shields of Hutchinson County participated in the "200-12" Project in 2011 only. He dedicated 65 acres to the project.

For the fifth and final year, Danny Krinke, Harold Grall, Phil Haaland, Brian Bezner, Brent Clark, David Ford, Hartley Feeders, Tommy Laubhan, Joe Reinart, and Richard Schad will all participate in the project.

Methods

Each cooperator individually selected fields irrigated by center pivot systems for his demonstration. In 2012, the district added a control field, managed by the cooperator, to compare the demonstration results to normal farming practices. Prior to 2012, the district used the records from the cooperator's farming operation to provide a comparison. Irrigation was managed within the NPGCD's "200-12" project protocols and guidelines in one field called the "200-12". Each cooperator managed irrigation in the second field, called the Control, according to his normal practices. Each cooperator individually chose commercially available corn hybrids based on their

experience as growers. Seeding and fertilizer rates, as well as pesticide and herbicide applications, were also selected by each cooperator. At each demonstration field, the district installed water meters to record and verify the amount of irrigation applied on each field, rain gauges to measure rainfall, gypsum block moisture sensors at 1, 2, 3, 4 and 5 foot depths in the crop's root zone to monitor soil water content, and AquaSpy® continuous soil moisture monitoring probes down to 60 inches.

AquaSpy® Continuous Soil Moisture Monitoring

The AquaSpy probe uses sensors utilizing capacitance base technology to determine a moisture level at the various depths. These sensors are spaced every four inches and determine a moisture level every three minutes. A communications tower located near the probe communicates the probe data to a secure server every fifteen minutes via cellular networks. The data is viewable from the AquaSpy Website.

Figure 4: The summary graph for all sensors in an AquaSpy Probe. A) The green area is the optimal level for the soil moisture for the crop. B) The red line represents the refill point. C) The blue line represents the field capacity for the soil.

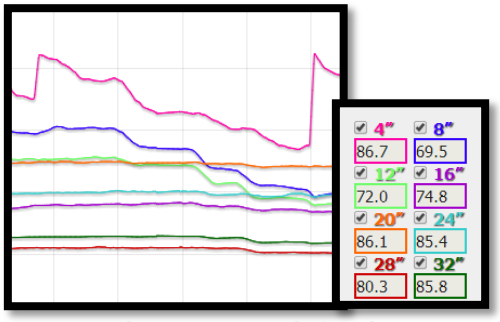


Figure 3: The sensor graph for the AquaSpy Probes

Figure 4 is an example of a graph summarizing all of the sensor's data. The rises in the graph indicates an irrigation or rainfall event and the falls in the graph are the result of plant use. The stair stepping effect of the falls in the graph is the result of the plant intake rate changing from day to night, with the highest intake rate during the day. Figure 3 is the graph of the individual sensors of the AquaSpy Probes. This graph allows the user view the water use of each sensor level. In this example, the crop is

using the soil moisture at the 4, 8 and 12 inch levels, showing the root zone is 12 inches deep. For more information regarding AquaSpy's product, visit their website at www.aquaspy.com.

PivoTrac™ Remote Continuous Tracking and Control

Each irrigation system was equipped with PivoTrac remote continuous tracking and control to monitor and manage irrigation application frequency. The PivoTrac website provides real-time information of the pivot, i.e. current status, time running wet, irrigation applied, rainfall, application rate, pivot speed, current position. For more information regarding PivoTrac's product, visit their website at www.texaspivot.com.

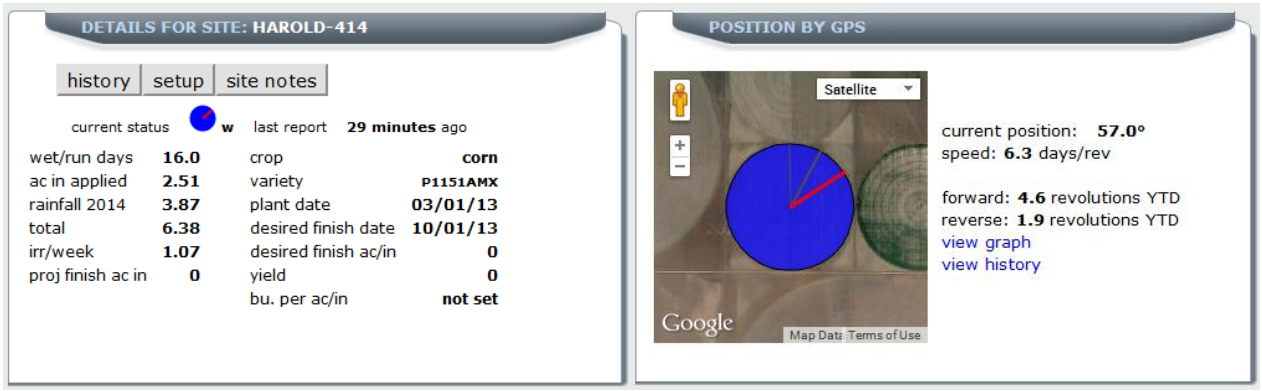


Figure 5: An example of the information provided by the PivoTrac's service.

Better Harvest's Nitrogen Management Program

Better Harvest provides a nitrogen management program to maximizing the beneficial use of applied nitrogen. The program collects four samples; pre plant, 4 leaf, tassel and harvest; over the growing season. A report is sent to the producer with recommendation. For more information regarding Better Harvest's program, visit their website at www.betterharvest.com.

HydroBio Advanced Remote Sensing

HydroBio uses satellite imagery to estimate the plant water requirement and uses the information to produce an irrigation schedule for the crop. Other benefits include imagery that can identify areas of concerns within the field. The user accesses the prescriptions and supporting data through a web-based system. The district decided to use the HydroBio's services in a limited quantity for the fourth year of the project. Figure 6 is an example of the data received for the services. The lighter areas represent the area of highest water use and the darker areas represent the area of lowest

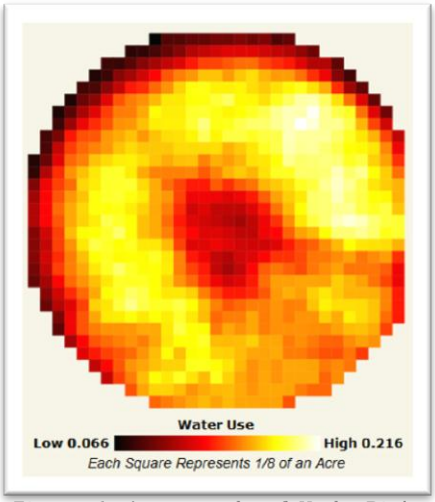


Figure 6: An example of HydroBio's satellite imagery.

water use.

The purpose was to learn the function of the imagery process and the potential as an additional beneficial irrigation and water management tool for growers. The satellite imagery appears promising, however additional improvements are needed in monitoring soil moisture, especially beginning soil moisture. For more information regarding HydroBio's service, visit their website at www.hydrobioars.com.

CropMetrics Electrical Conductivity Mapping

CropMetrics use electromagnetic (EM) instrument to provide relative field specific differences to potentially improve crop production within the survey area. Resulting survey data is used primarily to guide precision agriculture practices such as variable rate seeding, fertilizer and irrigation. The survey provides seven layers of data. The layers are aspect, depressions, dual EM topsoil, dual EM subsoil, elevation, landscape and slope. The dual EM subsoil layer describes relative differences in soil texture and associated characteristics to approximately 36 inches. Dual EM Subsoil data is important to managing irrigation and writing Variable Rate Irrigation (VRI) prescriptions. The dual EM subsoil layer is use primarily to write VRI prescriptions. The VRI prescriptions were loaded on PivoTrac's automatic center pivot speed control system. Variable Rate Irrigation by center pivot speed control was conducted in two "200-12" fields and one Control field in 2012 to initiate and learn the process. VRI prescriptions were written for three fields in 2013 but never initiated because of unexpected center pivot and pump interruptions. For more information regarding CropMetrics' service, visit their website at www.cropmetrics.com.

Data Collection

During the growing season, district's personnel collected data and maintained recording equipment weekly in each demonstration field. Cooperators and the district conservationist used the real-time data from AquaSpy and PivoTrac along with the data collected at least weekly from each demonstration field to monitor crop and soil moisture conditions, as well as to schedule irrigation frequency and volumes in the "200-12" fields. Where the "200-12" and Control fields were both irrigated by the same center pivot system, PivoTrac delivered a text message to the district conservationist who recorded when irrigation stopped in one field and began in the other field.

The time the irrigation system was in the "200-12" or Control field, along with weekly gallon per minute (gpm) water meter readings, established a method to track irrigation. All demonstrations began at planting and ended at harvest, which each cooperator managed. The district compared harvest and irrigation results from the "200-12" field with that from the Control field for each grower, and to that of other fields which the cooperator farmed. Yields for each field were adjusted to reflect 15.5% moisture content for corn based on the formula used by the National Corn Growers Association. The district analyzed production gains and losses based on accepted

corn price and growers expenses relating to irrigation, seed, fertilizer and harvest costs. The district did not analyze land costs because land costs are highly variable between growers and across the district.

Results

2010 Crop Season

In 2010, three district directors (Harold Grall, Danny Krienke and Phil Haaland) dedicated their own irrigated acres for the first year of the "200-12" Project. The cooperators implemented new and proven irrigation management technologies and practices to aid in the strategic management of each reduced irrigation water demonstration site.

Harold Grall of Moore County dedicated 120 acres for the on-farm demonstration. He saved ten inches of irrigation for the year when compared to his normal practices. Mr. Grall has an Actual Production History (APH) of 217 bushels for the field in the previous nine years. He yielded 198 bushels in the "200-12" program in 2010. His farm average yield for other fields was ten percent less than normal. Mr. Grall saved $100.34 per acre in costs on corn produced this year due to the reduction in irrigation, seed, fertilizer and harvest costs. The reduced corn yield cost $89.87 per acre. The demonstration's net gain was $10.47 per acre with ten inches less irrigation water used compared to typical production from the same field.

Danny Krienke of Ochiltree County dedicated 120 acres for the on-farm demonstration. He saved five inches of applied irrigation for the year when compared to his normal practices. Mr. Krienke has an adjusted APH of 196 bushels from this field for 2010. The field demonstration produced 192 bushels for the year. Mr. Krienke saved $61 per acre in cost on corn produced in 2010 due to the reduction in irrigation, seed, fertilizer, and harvest costs. The reduced corn yield cost $18.92 per acre. The demonstration's net gain was $42.08 per acre, with 5 inches less irrigation water used compared to typical production from the same field.

Phil Haaland of Hartley County dedicated 30 acres for the district's on-farm demonstration from a 120 acre field in which he was demonstrating hybrid seeding rates for a separate demonstration project. On the 30 acres, Haaland saved eleven inches of applied irrigation for the year. Haaland's field has an APH of 240 bushels and came in with 191 bushels for the year. In simulating a 250 gallons per minute well on a 120 acre circle, Mr. Haaland saved $122.46 per acre in costs on corn produced this year due to the reduction in irrigation, seed, fertilizer and harvest costs. The reduced corn yield cost $231.77 per acre. This demonstration's net loss was $109.31 per acre with eleven inches less irrigation water used compared to a typical production from the same field. If the production capacity of the irrigation pivot was actually 250 gallons per minute, Haaland said he would have only irrigated half a circle (60 acres) which would have increased his yield and would have been closer to break-even.

In 2010, the project reduced irrigation in the "200-12" fields by 177.50 acre-feet (7.89 inches). Table 2 shows water savings and results for the 2010 growing season.

Table 2: 2010 Water Savings and Results

2010 Results

Producer	Field Size (ac)	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)	Yield (bu/ac)	Net Gain ($/ac)
Harold Grall	120	10.86	108.60	10.00	100.00	198	$ 10.47
Danny Krienke	120	11.76	117.60	5.00	50.00	192	$ 42.08
Phil Haaland	30	11.20	28.00	11.00	27.50	191	$ (109.31)
Total	**270**	**11.30**	**254.20**	**7.89**	**177.50**	**194**	**$ 11.21**

Notes: The water savings is compared to the producer's other fields.

2011 Crop Season

2010 was a year with above average rainfall, while 2011 was the opposite, with well below average rainfall. The total lack of supplemental rainfall showed early that our goal of 12 inches of irrigation was not likely to be achievable; however one "200-12" field came close. Due to extreme drought, six participants were forced to divert water to fields that required more input to prevent devastating financial loss.

Harold Grall of Moore County dedicated 120 acres to the on-farm demonstration. Grall saved ten inches of irrigation for the year compared to his normal practices on twenty other fields. Mr. Grall has an Actual Production History (APH) of 217 bushels for the field in the previous nine years. Grall's acreage yielded 198 bushels in the "200-12" Project in 2010 and 178 in 2011. Even though the yield was 20 bushels less per acre in 2011, it was still considered an excellent result given the much lower than normal rainfall received. His farm average yield for other fields was 28 percent less than normal. Production averaged 164 bushels per acre on the other fields, 14 bushels less than the 178 harvested in the "200-12" field. Mr. Grall saved $94.64 per acre in reduced irrigation, seed and fertilizer but increased harvest costs in 2011. The 14 bushel increase in corn yield amounts to $90.72 per acre. The demonstration's net gain was $185.36 per acre with ten inches less irrigation compared to production from the average of Grall's twenty other fields.

Steve Shields of Hutchinson County dedicated 65 acres to the district's on-farm demonstration. Shield's field has an APH of 180 bushels and produced 153 bushels during the 2011 demonstration year. Shields states the 153 bushels per acre yield is about average in comparison to seven other fields he farms where production ranged from 126 to 190 bushels. He thinks corn yields were 25 to 30 percent less on his farms in 2011. Shields used about five inches of irrigation in pre-water and following planting, battling the challenging climatic conditions. He did not save any money in reduced irrigation, fertilizer, seed and harvest costs. Irrigation was similar to his other fields. A first year project cooperator using a new center pivot, Shields says

he is okay with the 153 bushel yield considering the dry conditions. He remarked, "I had to make a crop."

Danny Krienke of Ochiltree County dedicated 120 acres to the on-farm demonstration. Krienke reduced irrigation by seven inches for the season compared to normal practices for four other fields he farms, where irrigation totaled 28 inches and production averaged 168 bushels per acre. Krienke had an adjusted APH of 196 bushels from the field for 2010. The field demonstration produced 192 bushels during the 2010 demonstration and 121 bushels in 2011. He calculated corn production was 28 percent less than normal from his fields in 2011. Krienke saved $110.19 per acre in cost on corn produced in 2011 due to the reduction in irrigation, seed, fertilizer, and harvest costs. The reduced corn yield cost $304.56 per acre.The demonstration's net loss was $194.37 per acre, with 7 inches less irrigation water used compared to his four other fields. Krienke was forced to make pump repairs the first week in July at a critical plant growth stage. The five days of no irrigation limited corn yield and was typical of what happens with limited pumping capacity.

Phil Haaland had expectations to harvest a grain crop, but near 100 degree temperatures and no meaningful rainfall from May thru September prevented development of a harvestable crop. His 15 acres were harvested for corn silage in July.

Dennis Buss and Hartley Feed Yard made a diligent effort to produce a grain crop on his 62 acres. The plants, already under moisture stress were blasted beyond recovery by 113 degree temperatures and 45 mph winds during a weekend in June. His two wells declined by 100 gallons per minute and available water were diverted to another 60 acres, which also failed. The field was harvested for silage in July.

Brian Bezner received 2.25 inches of rainfall in June and had a promising crop, but did not have sufficient irrigation water to maintain the potential. His 60 acres were harvested for silage.

James Born experienced mechanical failures and down time with a center pivot with limited water already committed to too many acres on a first year farm. His 115 acres of corn stressed in June and was abandoned in favor of grain sorghum that was planted later.

Chad Hicks and 14 Mile Ranch could not irrigate the demonstration as planned because water was also committed to other crop acres in combination with additional wells. His 50 acres were abandoned in July after plants became severely stressed. In 2011, many wells were over extended and could not keep up with the demand.

Joe Reinart shared water from the well that was to irrigate his demonstration with other crop acres. The plants became severely stressed and the 75 acres were abandoned in late June. Three hundred five of the 682 acres (45 %) committed to the "200-12" demonstration project were harvested as planned, 137 (20 %) were harvested for corn silage and 240 (35 %) were abandoned.

In 2011, the project reduced irrigation in the "200-12" fields by 525.25 acre-feet (9.24 inches). Table 3 is the water savings and results for the 2011 growing season.

Table 3: 2011 Water Savings and Results

2011 Results

Producer	Field Size (ac)	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)	Yield (bu/ac)	Net Gain ($/ac)
Harold Grall (1)	120	18.78	187.80	9.50	95.00	178	$ 185.36
Steve Shields (1)	65	31.21	169.05	0.00	0.00	153	-
Danny Krienke (1)	20	21.32	35.53	7.00	11.67	121	$ (194.37)
Danny Krienke (1)	100	23.56	196.33	5.00	41.67	131	$ (129.57)
Phil Haaland (2)	15	13.09	16.36	7.90	9.88	Silage	-
Hartley Feeders (2)	62	12.02	62.10	9.00	46.50	Silage	-
Brian Bezner (2)	60	14.22	71.10	6.80	34.00	Silage	-
James Born (3)	115	7.07	67.75	13.90	133.21	Abandoned	-
Chad Hicks (3)	50	6.08	25.33	14.90	62.08	Abandoned	-
Joe Reinart (3)	75	6.37	39.81	14.60	91.25	Abandoned	-
Total	**682**	**15.33**	**871.19**	**9.24**	**525.25**	**146**	**$ 7.92**

Notes:
(1) The water savings is compared to the producer's other fields. (Sustainable)
(2) The water savings is compared to AgriPartner Program Irrigation of 21 inches of water on the same size field. Not Sustainible (Silage)
(3) The water savings is compared to AgriPartner Program Irrigationfor 21 inches of water on the same size field. Not Sustainible (Abandoned)

2012 Crop Season

Overall, 2012 was better than 2011 but beginning soil water and seasonal rainfall was below normal and limited production to less than expected and needed. High temperatures during the last two weeks in July and the first week in August, with only limited to no rainfall created the need for more irrigation. Six fields received hail damage that reduced harvest yields. Due to the lack of supplemental rainfall, one participant was forced to divert water to fields that required more input to prevent devastating financial loss. Another participant harvested silage.

Joe Reinart of Sherman County dedicated 135 acres to the on-farm demonstration in two separate fields irrigated by different center pivot systems. Reinart strip tilled and planted 60 acres of corn at 25,000 seeds per acre May 16 for his "200-12" field. He strip tilled and planted 75 acres at 33,000 seeds per acre on April 23 for his Control field. The "200-12" field produced a 170 bushel per acre corn yield. Irrigation totaled 18.20 inches. Production in the Control field was 205 bushels per acre, where seasonal irrigation was 21.25 and pre-water 6.50 inches to establish a total of 27.75 inches. The "200-12" field's net loss was $116.91 per acre with 9.55 inches more irrigation used compared to production from the "200-12" field. Reinart stated, "if you didn't have to count the outside and southwest side of the circle, it all would have been really good corn".

Harold Grall of Moore County dedicated 240 acres to the on-farm demonstration in two separate fields irrigated by different center pivots. Grall strip tilled and planted 120 acres of corn on May 28 at 28,000 seeds per acre for his "200-12" field. Grall planted 120 acres, also strip tilled, on May 24 at 26,000 seeds per acre for his Control field. The "200-12" field produced a 167 bushel per acre corn yield. Irrigation totaled 16.87 inches. Production in the Control field was 140 bushels per acre, where seasonal irrigation was 18.07 inches. There was no pre-water in either field. In comparison, the "200-12" field produced 27 more bushels per acre than the Control with 1.20 less inches of irrigation. The "200-12" field's net gain was $163.66 per acre with 1.20 inches less irrigation used compared to production from the Control field.

Tommy Laubhan of Lipscomb County dedicated 122 acres in the same field irrigated by the same center pivot to the on-farm demonstration. Laubhan strip tilled and planted 61 acres of corn in the southwest quarter of the circle on May 4 at a seeding rate of 31,000 seeds per acre for his "200-12" field. He planted the northwest quarter, 61 acres, also strip tilled, on May 4 at 31,000 seeds per acre for his Control field. The "200-12" field produced a 165 bushel per acre corn yield. Irrigation totaled 20.31 inches. Production in the Control field was 174 bushels per acre. Seasonal irrigation totaled 22.78 inches. There was no pre-season irrigation. The "200-12" field's net loss was $44.40 per acre with 2.47 inches additional irrigation used compared to production from the "200-12" field. Laubhan thinks the primary reason corn yield was greater in the Control is that the soil is better in more of the field for crop production. His farm average yield was 186 bushels per acre. Laubhan says the NPGCD "200-12" project provides good information and that he is glad to participate.

Hartley Feeders (Dennis Buss) of Hartley County dedicated 180 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Hartley Feeders strip tilled and planted 60 acres of corn on May 28 at 28,000 seeds per acre in the north half of the circle for their "200-12" field. Hartley Feeders planted 120 acres, also strip tilled, on May 28 at 28,000 seeds per acre for their Control field. The "200-12" field produced 160 bushels per acre corn yield. Irrigation totaled 20.68 inches. Production in the Control field was 115 bushels per acre, where seasonal irrigation totaled 21.54 inches. In comparison, the "200-12" field produced 45 more bushels per acre than the Control with 0.86 inches less irrigation. The "200-12" field's net gain was $285.38 per acre with 0.86 inches less irrigation used compared to production from the Control field. Dennis Buss thinks the primary reason for the lower yield in the Control field is that the field was not strip tilled when 3.45 inch rain fell in April. The "200-12" field was already strip tilled and stored more of the early season rainfall.

Brent Clark of Hartley County dedicated 240 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Clark strip tilled and planted 120 acres of corn on April 23 at 27,000 seeds per acre for his "200-12" field. Clark planted 120 acres on April 23 at 32,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced a 143 bushel per acre corn yield. Irrigation totaled 14.90 inches. Production in the Control field was

133 bushels per acre, where seasonal irrigation totaled 18.63 inches. In comparison, the "200-12" field produced ten more bushels per acre than the Control with 3.73 inches less irrigation. The "200-12" field's net gain was $120.40 per acre with 3.75 inches less irrigation used compared to production from the Control field. Both fields were affected by significant hail damage but recovered to produce a partial crop.

Richard Schad of Hansford County dedicated 164 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Schad strip tilled and planted 41 acres of corn on May 11 at 24,000 seeds per acre in the west half circle for his "200-12" field. Schad planted 123 acres on May 1 at 32,500 seeds per acre, also strip tilled, for his Control. The "200-12" field produced a 135 bushel per acre corn yield. Irrigation totaled 19.53 inches. Production in the Control field was 205 bushels per acre, where irrigation was 20.59 inches. Pre-season irrigation was 3.11 inches for the "200-12" field and 5.11 for the Control. In comparison, the Control field produced 72 more bushels per acre than the "200-12" with 1.06 additional inches of irrigation. The "200-12" field's net loss was $376.51 per acre with 1.06 inches more irrigation used compared to production from the "200-12" field. Schad stated, "I was really stretched for water to irrigate the fields. We had two new center pivots and another one moved to previous dry land acres. There were delays getting the irrigation systems ready and the crops planted. I thought we had lost too much of the crops in July when it didn't rain. However, crop yields were much better than expected earlier in the season."

Danny Krienke of Ochiltree County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Krienke strip tilled and planted 60 acres of corn on May 21 at 27,000 seeds per acre in the southwest quarter of the circle for his "200-12" field. He planted the southeast quarter circle 60 acres on May 21 at 27,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced a 134 bushel per acre corn yield. Irrigation totaled 24.57 inches. Production in the Control field was 131 bushels per acre. Seasonal irrigation totaled 26.62 inches. There was no pre-season irrigation. The "200-12" field produced three more bushels per acre than the Control and irrigation was 2.10 inches less. The "200-12" field's net gain was $28.59 per acre with 2.10 inches less irrigation used compared to production from the Control field.

Phil Haaland of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Haaland strip tilled and planted 15 acres from, 270 to 315 degrees in the circle, to corn on May 24 at 26,000 seeds per acre for his "200-12" field. He planted the remaining 105 acres in the circle on May 24 at 30,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced a 116 bushel per acre corn yield. Irrigation totaled 24.47 inches. Production in the Control field was 209 bushels per acre. Seasonal irrigation totaled 28.08 inches. Pre-season irrigation was 3.33 inches in both fields. In comparison, the "200-12" field produced 93 less bushels per acre than the Control and irrigation was 3.61 inches less. The "200-12" field's net loss was $554.32 per acre with 3.61 inches less

irrigation used compared to production from the Control field. It was too long between irrigations for the "200-12" field in July. Haaland says the lack of rainfall during the 2012 growing season created another unwanted challenge for growers.

Frische Brothers of Moore County dedicated 107 acres in one field irrigated by the same center pivot to the on-farm demonstration. Frische Brothers strip tilled and planted 53 acres of corn in the west half circle on May 6 at 28,000 seeds per acre for their "200-12" field. They planted the east half, 53 acres, on May 6 at 28,000 seeds per acre, also strip tilled, for their Control field. The "200-12" field produced a 104 bushel per acre corn yield. Irrigation totaled 13.52 inches. Production in the Control field was 105 bushels per acre. Seasonal irrigation totaled 14.64 inches. Pre-season irrigation was 1.50 inches in both fields. Plants in both fields were damaged by hail in mid-June. In comparison, the "200-12" field produced one less bushel per acre than the Control and irrigation was 1.12 inches less. The "200-12" field's net loss was $0.87 per acre with 1.12 inches less irrigation used compared to production from the Control field. Myles Frische said the hail caused a reduction in plant population plus additional evapotranspiration due to less canopy. And, with hindsight, the crop likely should have been replanted.

David Ford of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Ford strip tilled and planted 60 acres of corn in the south half circle on May 15 at 28,000 seeds per acre for his "200-12" field. He planted the north half circle 60 acres on May 15 at 32,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced an 86 bushel per acre corn yield. Irrigation totaled 15.61 inches. Production in the Control field was 173 bushels per acre. Seasonal irrigation totaled 20.64 inches. Pre-season irrigation was 2.60 inches in both fields. Both fields were damaged by hail at the seven leaf stage. The "200-12" field's net loss was $487.61 per acre with 5.03 inches less irrigation used compared to production from the Control field. Ford says the 2012 demonstration was not a good comparison due to the hail damage. Also Ford says that reduced corn irrigation following a previous cotton crop is not a good farming practice.

Chad Hicks & 14 Mile Ranch dedicated 360 acres in two fields irrigated by separate center pivot irrigation systems to the on-farm demonstration. Hicks strip tilled and planted 49 acres of corn on May 7 at 24,000 seeds per acre for his "200-12" field. Hicks planted 310 acres, also strip tilled, in the north half of a 620 acre circle on May 17 at 28,000 seeds per acre for his Control field. The "200-12" field produced a 14 bushel per acre corn yield. Irrigation totaled 6.20 inches. There was not sufficient water available to irrigate the crop as needed after mid- June. The water was applied on larger crop acres that included the Control field. Production in the Control field was 218 bushels per acre, where seasonal irrigation and pre-water totaled 23.74 inches. Preseason irrigation was 1.95 inches in the "200-12" field and 3.89 in the Control. The "200-12" field's net loss was $1024.54 per acre with 17.54 inches more irrigation used compared to production from the "200-12" field. Unfortunately, Hicks lack of available water for his "200-

12” field when rainfall is less than normal is a condition all growers is addressing, and it is the purpose of the NPGCD’s “200-12” reduced corn irrigation project.

Brian Bezner dedicated 244 acres in two fields irrigated by separate center pivot irrigation systems to the on-farm demonstration. Bezner strip tilled and planted 120 acres of corn on May 16 at 27,000 seeds per acre for his “200-12” field. He planted 124 acres on June 2, following wheat, at 33,000 seeds per acre, also strip tilled, for his Control field. The “200-12” field was harvested for corn silage on August 17. With only limited rainfall, available irrigation water was not sufficient to produce a grain crop. The field produced 8.73 tons of silage per acre. Irrigation totaled 9.54 inches. Production in the Control field was 194 bushels per acre, where seasonal irrigation totaled 26.59 inches. There was no pre-season irrigation in either field. The “200-12” field’s net loss for corn grain is $929.26 per acre with 17.05 inches more irrigation used compared to production from the “200-12” silage field.

In 2012, the project reduced irrigation in the “200-12” fields by 404.51 acre-feet (5.93 inches). Table 4 is the water savings and results for the 2012 growing season.

Table 4: 2012 Water Savings and Results

2012 Results

Producer	Field Size (ac)	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)	Yield (bu/ac)	Net Gain ($/ac)
Joe Reinart 200-12	60	18.20	91.00	9.55	47.75	170	$ (116.91)
Joe Reinart Control	75	27.75	173.44	-	-	205	-
Harold Grall 200-12	120	16.87	168.70	1.20	12.00	167	$ 163.66
Harold Grall Control	120	18.07	180.70	-	-	140	-
Tommy Laubhan 200-12	61	20.31	103.24	2.47	12.56	165	$ (44.40)
Tommy Laubhan Conrtol	61	22.78	115.80	-	-	174	-
Hartley Feeders 200-12	60	20.68	103.40	0.86	4.30	160	$ 285.38
Hartley Feeders Control	120	21.54	215.40	-	-	115	-
Brent Clark 200-12	120	14.90	149.00	3.73	37.30	143	$ 120.40
Brent Clark Control	120	18.63	186.30	-	-	133	-
Richard Schad 200-12	41	19.53	66.73	1.06	3.62	135	$ (376.51)
Richard Schad Control	123	20.59	211.05	-	-	207	-
Danny Krienke 200-12	60	24.57	122.85	2.05	10.25	134	$ 28.59
Danny Krienke Control	60	26.62	133.10	-	-	131	-
Phil Haaland 200-12	15	24.47	30.59	3.61	4.51	116	$ (554.32)
Phil Haaland Control	105	28.08	245.70	-	-	209	-
Frische Brothers 200-12	53	13.52	59.71	1.12	4.95	104	$ (0.87)
Frische Brothers Control	53	14.64	64.66	-	-	105	-
David Ford 200-12	60	15.61	78.05	5.03	25.15	86	$ (487.61)
David Ford Control	60	20.64	103.20	-	-	173	-
Chad Hicks 200-12	49	6.02	24.58	17.54	71.62	14	$(1,024.54)
Chad Hicks Control	310	23.74	613.28	-	-	218	-
Brian Bezner 200-12 (1)	120	9.54	95.40	17.05	170.50	Silage	-
Brian Bezner Control	124	26.59	274.76	-	-	194	-
200-12 Total	**819**	**16.02**	**1093.25**	**5.93**	**404.51**	**148**	**$ (73.33)**
Control Total	**1331**	**270**	**2517.39**	**-**	**-**	**167**	

Notes: All water savings is based on the control field for each producer.
(1) Brian Bezner cut his 200-12 field for silage.

All 2152 acres dedicated to the project in 2012 were harvested. Only two percent (49 acres) of the "200-12" field acreage was basically abandoned due to the lack of available water. Another 5 percent (120 acres) was harvested as corn silage. Corn yields averaged 138 bushels per acre in ten "200-12" fields. Irrigation averaged 18.86 inches. Average Irrigation, rainfall plus net soil water totaled 25.36 inches. Production averaged 167 bushels per acre in 12 Control fields. Average Irrigation was 22.47 inches. Irrigation, rainfall and net soil water averaged 27.78 inches.

2013 Crop Season

In 2013, eleven cooperating producers dedicated twenty-two demonstration fields encompassing 1672 acres. All 1672 acres dedicated to the project were harvested for corn grain. Corn yields averaged 200 bushels per acre in eleven "200-12" fields. Irrigation averaged 18.36 inches. Average pre-water in five "200-12" fields was 2.37 inches. Production averaged 11.17 bushels (625 lbs.) per inch of irrigation. Average Irrigation, rainfall plus net soil water totaled 26.25 inches. Production averaged 226 bushels per acre in eleven Control fields. Average Irrigation was 23.28 inches. Production was 9.84 bushels (551 lbs.) per inch of irrigation. Irrigation, rainfall and net soil water averaged 31.34 inches. No pre-water was applied in 10 of the 22 fields. Two of the practices used for the "200-12" fields are only slightly less than those used in the Control fields. Net return per inch of irrigation averaged $33.73 for the "200-12" fields compared to $30.09 for the Control fields. Results from the 2013 cooperating producers are as follows:

Joe Reinart of Sherman County dedicated 92 acres to the on-farm demonstration in two separate fields irrigated by different center pivot systems. Reinart strip tilled and planted 27 acres of corn at 25,000 seeds per acre on June 12 for his "200-12" field. He strip tilled and planted 65 acres at 32,000 seeds per acre on May 5 for his Control field. The "200-12" field produced 200 bushels per acre. Irrigation totaled 12.55 inches. Reinart only read and used the soil probe to irrigate the "200-12" field. Production in the Control field was 238 bushels per acre, where seasonal irrigation was 24.11 and pre-water 4.15 inches to establish a total of 28.26 inches. The "200-12" field's net loss was $18.14 per acre with 15.71 inches more irrigation used compared to production from the "200-12" field. Reinart stated, "An additional 600 acres across the rest of our farm that mirrored the "200-12" field averaged 185 bushels per acre. And that "we will continue to plant early and late corn using the strategies learned from the "200-12" project".

Harold Grall of Moore County dedicated 240 acres to the on-farm demonstration in two separate fields irrigated by different center pivots. Grall strip tilled and planted 120 acres of corn on June 4 at 26,000 seeds per acre for his "200-12" field. Grall planted 120 acres, also strip tilled, on June 2 at 24,000 seeds per acre for his Control field. The "200-12" field produced 198 bushels per acre. Irrigation totaled 15.06 inches. Production in the Control field was 195 bushels per acre, where in-seasonal irrigation was 16.75 inches and pre-water 6.26 inches. Total irrigation for the Control field was 23.01 inches. Grall said "Soil water was low in the Control field following the 2012 crop, so I decided to pre-water to help make a crop, considering I have only

300 gallons per minute to irrigate 120 acres. The soil water was better in the 200-12 field." In comparison, the "200-12" field produced 3 more bushels per acre than the Control with 7.95 less inches of irrigation. The "200-12" field's net gain was $49.64 per acre with 7.95 inches less irrigation used compared to production from the Control field.

Brent Clark of Hartley County dedicated 244 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Clark strip tilled and planted 122 acres of corn on April 25 at 28,000 seeds per acre for his "200-12" field. Clark planted 122 acres on April 25 at 32,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced a 219 bushel per acre corn yield. Irrigation totaled 17.26 inches. Production in the Control field was 239 bushels per acre, where irrigation totaled 20.21 inches. In comparison, the Control field produced 20 more bushels per acre than the "200-12" field with 2.95 more inches of irrigation. The "200-12" field's net loss was $41.93 per acre with 2.95 inches additional irrigation used compared to production from the "200-12" field. Clark said "The corn in the "200-12" field stressed for water more than I wanted when the pump was being repaired during five days at the critical growth stage during the first week in July." Variable rate irrigation (VRI) was planned for the "200-12" field but not initiated due to the untimely pump repair.

Danny Krienke of Ochiltree County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Krienke strip tilled and planted 40 acres of corn on May 18 at 28,000 seeds per acre in the northeast quarter of the circle for his "200-12" field. He planted 40 acres in the north portion of the circle on May 18 at 28,000 seeds per acre, also strip tilled, for his Control field. The northwest 40 acres were planted at 36,000 seeds per acre on June 25 for another comparison. The corn hybrid was short season. The "200-12" field produced 231 bushels per acre. Irrigation totaled 19.04 inches. Production in the Control field was 240 bushels per acre. Seasonal irrigation totaled 25.15 inches. There was no pre-season irrigation. The Control field produced nine more bushels per acre than the "200-12" and irrigation was 6.11 inches more. The "200-12" field's net loss was $2.72 per acre with 6.11 inches more irrigation used compared to production from the "200-12" field. Yield from the late planted field was 201 bushels per acre. Irrigation totaled 19.96 inches. The "200-12" field's net gain was $149.45 per acre with 0.92 inches less irrigation compared to the late planted short season hybrid field.

Brian Bezner dedicated 222 acres in two fields irrigated by separate center pivot irrigation systems to the on-farm demonstration. Bezner strip tilled and planted 98 acres of corn on May 20 at 27,000 seeds per acre for his "200-12" field. He planted 124 acres on May 17 at 32,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced 206 bushels per acre. Irrigation was 18.92 inches. Production in the Control field was 274 bushels per acre, where seasonal irrigation totaled 22.86 inches. There was no pre-season irrigation in either field. The "200-12" field's net loss for corn grain is $256.72 per acre with 3.94 inches more irrigation used compared to production from the "200-12" field. Variable rate irrigation (VRI) was planned in

conjunction with Syngenta but never initiated because separate soil moisture sensors did not indicate the need.

Richard Schad of Hansford County dedicated 165 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Schad strip tilled and planted 41 acres of corn on May 18 at 26,000 seeds per acre in the east half circle for his "200-12" field. Schad planted 124 acres on May 17 at 32,000 seeds per acre, also strip tilled, for his Control. The "200-12" field produced a 196 bushel per acre corn yield. Pre-Irrigation was 3.20 inches and in-season irrigation was 15.76, making a total of 18.96 inches. Production in the Control field was 230 bushels per acre, where pre-water was 2.80 inches, in-season irrigation was 14.59 and total irrigation was 17.39 inches. In comparison, the Control field produced 34 more bushels per acre than the "200-12" with 1.57 less inches of irrigation. The "200-12" field's net loss was $121.65 per acre with 1.57 inches less irrigation used compared to production from the "200-12" field. Schad stated, "two timely rains came immediately following irrigation of the "200-12" fields, which could have reduced irrigation had I known. I am stretched for water, rotate irrigation between four center pivots and must keep the water moving".

Frische Brothers of Moore County dedicated 107 acres in one field irrigated by the same center pivot to the on-farm demonstration. Frische Brothers strip tilled and planted 53 acres of corn in the west half circle on May 7 at 28,000 seeds per acre for their "200-12" field. They planted the east half, 53 acres, on May 7 at 28,000 seeds/acre, also strip tilled, for their Control field. The "200-12" field produced a 176 bushel per acre corn yield. Pre-Irrigation was 3.00 inches, in season 14.01 and the total 17.01 inches. Production in the Control field was 223 bushels per acre. Pre-water was 3.00 inches, seasonal 19.40 and total irrigation 22.40 inches. In comparison, the "200-12" field produced 47 less bushels per acre than the Control and irrigation was 5.39 inches less. The "200-12" field's net loss was $189.55 per acre with 5.39 inches less irrigation used compared to production from the Control field. Seasonal rainfall totaled only 4.85 inches. Frische Brothers is another demonstration field where rainfall was similar to previous years.

Phil Haaland of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Haaland strip tilled and planted 4 acres from, 124 to 136 degrees in the circle, to corn on May 15 at 28,000 seeds per acre for his "200-12" field. He planted the remaining 116 acres in the circle on May 15 at 35,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced a 191 bushel per acre corn yield. Irrigation totaled 19.04 inches of which 3.01 were pre-water. Production in the Control field was 287 bushels per acre. Seasonal irrigation totaled 27.35 inches. Pre-season irrigation was 4.93 inches making total irrigation 32.28 inches. In comparison, the "200-12" field produced 96 less bushels per acre than the Control and irrigation was 13.24 inches less. The "200-12" field's net loss was $312.25 per acre with 13.24 inches less irrigation used compared to production from the Control field. Haaland said "The lack of beneficial rainfall here during the growing season, like in other areas, made continuous irrigation essential."

David Ford of Hartley County dedicated 120 acres in one field irrigated by the same center pivot to the on-farm demonstration. Ford strip tilled and planted 60 acres of corn in the east half circle on May 15 at 28,000 seeds per acre for his "200-12" field. He planted the west half circle 60 acres on May 15 at 28,000 seeds per acre, also strip tilled, for his Control field. The "200-12" field produced a 178 bushel per acre corn yield. Irrigation totaled 19.08 inches, of which 2.31 inches were pre-water. Production in the Control field was 191 bushels per acre. Seasonal irrigation was 19.97 inches, pre-water 2.10 and total irrigation 22.07 inches. The "200-12" field's net loss was $42.54 per acre with 2.99 inches less irrigation used compared to production from the Control field. Ford said "Blowing was a problem early, especially on about 10 acres in the west Control half, where plant population was decreased. I could not get it stopped. Also, there was not enough timely rainfall to help when needed most." Ford added "Reduced corn irrigation following a previous cotton crop is not a good farming practice." The 2013 corn crop followed wheat.

Hartley Feeders (Dennis Buss) of Hartley County dedicated 120 acres in two separate fields irrigated by different center pivots to the on-farm demonstration. Hartley Feeders strip tilled and planted 60 acres of corn on May 18 at 28,000 seeds per acre in the north half of the circle for their "200-12" field. Hartley Feeders planted the north half 60 acres, also strip tilled, on May 19 at 28,000 seeds per acre for their Control field. The "200-12" field produced a 218 bushel per acre corn yield. Irrigation totaled 24.01 inches, of which pre-water was 1.56 inches. Production in the Control field was 176 bushels per acre, where seasonal irrigation was 20.35 inches, pre-water .72 and total irrigation 21.07 inches. In comparison, the "200-12" field produced 42 more bushels per acre than the Control with 2.94 inches more irrigation. The "200-12" field's net gain was $181.78 per acre with 2.95 inches more irrigation used compared to production from the Control field. Dennis Buss said "The soil probe really helped save water this summer. I was able to stop irrigation for the "200-12" field a whole week, twice." "Also Better Harvest saved a lot of money in fertilizer and corn was less stressed," said Buss. Buss added "The Control field has an area of less productive soil that likely contributed to the reduced yield there, plus the crop used all irrigation and soil water available in July. A good rain then would have helped".

Tommy Laubhan of Lipscomb County dedicated 122 acres in the same field irrigated by the same center pivot to the on-farm demonstration. Laubhan strip tilled and planted 61 acres of corn in the southeast quarter of the circle on May 12 at a seeding rate of 31,700 seeds per acre for his "200-12" field. He planted the northeast quarter, 61 acres, also strip tilled, on May 12 at 31,700 seeds per acre for his Control field. The "200-12" field produced a 189 bushel per acre corn yield. Irrigation totaled 21.07 inches. Production in the Control field was 191 bushels per acre. Seasonal irrigation totaled 21.40 inches. There was no pre-season irrigation. The "200-12" field's net loss was $7.40 per acre with 0.33 inches additional irrigation used compared to production from the "200-12" field. Laubhan lost his center pivot on June 3 in a storm that also dumped 4.05 inches of rainfall on his two fields. A new system was in place and running on June 15. Two hail storms in August damaged his crop resulting in 35 percent adjustment by insurance.

Laubhan said "The NPGCD "200-12" project provides good information and I am glad to participate."

In 2013, the project reduced irrigation in the "200-12" fields by 179.63 acre-feet (3.14 inches). Table 5 shows the water savings and results for the 2013 growing season.

Table 5: 2013 Water Savings and Results

2013 Results

Producer	Field Size (ac)	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)	Yield (bu/ac)	Net Gain ($/ac)
Joe Reinart 200-12	27	12.55	28.24	15.71	35.35	200	$ (18.14)
Joe Reinart Control	65	28.26	153.08	-	-	238	-
Harold Grall 200-12	120	15.06	150.60	1.69	16.90	198	$ 49.64
Harold Grall Control	120	23.01	230.10	-	-	195	-
Brent Clark 200-12	122	17.26	175.48	2.95	29.99	219	$ (41.93)
Brent Clark Control	122	20.21	205.47	-	-	239	-
Danny Krienke 200-12	40	19.04	63.47	6.11	20.37	231	$ (2.72)
Danny Krienke Control	40	25.15	83.83	-	-	240	-
Brian Bezner 200-12	98	18.92	154.51	3.94	32.18	206	$ (256.72)
Brian Bezner Control	124	22.86	236.22	-	-	274	-
Richard Schad 200-12	41	18.96	64.78	0.00	0.00	196	$ (121.65)
Richard Schad Control	124	17.39	179.70	-	-	230	-
Frische Brothers 200-12	53	17.01	75.13	5.39	23.81	176	$ (189.55)
Frische Brothers Control	53	22.40	98.93	-	-	223	-
Phil Haaland 200-12	4	19.04	6.35	13.24	4.41	191	$ (312.25)
Phil Haaland Control	116	32.28	312.04	-	-	287	-
David Ford 200-12	60	19.08	95.40	2.99	14.95	178	$ (42.54)
David Ford Control	60	22.07	110.35	-	-	191	-
Hartley Feeders 200-12	60	22.45	112.25	0.00	0.00	218	$ 181.78
Hartley Feeders Control	60	21.06	105.30	-	-	176	-
Tommy Laubhan 200-12	61	21.07	107.11	0.33	1.68	189	$ (7.40)
Tommy Laubhan Control	61	21.40	108.78	-	-	191	-
200-12 Total	**686**	**18.08**	**1033.30**	**3.14**	**179.63**	**200**	**$ (48.54)**
Control Total	**945**	**23.16**	**1823.80**	**-**	**-**	**226**	

Notes: All water savings is based on the control field for each producer.

Educational Outreach Activities

Throughout the initial 5-years of the "200-12 Project," the district maintained a focus on educational outreach and best practices transfer. The district held multiple field days across the district each of the first four years. The field days averaged about 100 attendees annually and allowed producers and other interested stakeholders to see first-hand what practices were being used and how they were working.

In 2010, the district hosted the field day in Perryton, TX, but joined with Pioneer Hybrid, Inc. for the Dalhart Field Day and Texas A&M AgriLife Research for the field day at the North Plains

Research Field in Etter, TX. With the addition of the Efficient Profitable Irrigation on Corn (EPIC) project in years 2011-2013, Texas A&M AgriLife Extension began co-hosting the field fays and sharing information on the district-funded and complementary EPIC project. In 2011, the district also began to cooperate with Pioneer Hybrid, Inc. to present information on the "200-12 Project" at Pioneer's Annual Winter Crop Production Clinics in January. Partnering with other groups who share common interests allowed the reach of in-district presentations to be increased to about 300 attendees annually.

Figure 7: Steve Walthour, General Manager, addresses the 2010 Commodities Symposium in Amarillo.

In addition to the field days and crop clinics, district's board members and staff have presented data from the project at a variety of meetings each year. Not only has the district taken the program to the people, but the district has hosted multiple groups who were interested in the project including, corn growers from Iowa, a delegation from Mexico, as well as Texas State legislators.

The "200-12 Project" also received the Texas Water Conservation Advisory Committee's Blue Legacy Award in 2011 and the Texas Commission on Environmental Quality's Environmental Excellence Award in 2012. Both awards created opportunities for more outreach through media releases and presentations both inside and outside the district. The following is a sample of the educational outreach activities pertaining to the "200-12 Project" during the first four years of the project:

January – Pioneer Crop Production Clinic in Dalhart, TX (2011-14)

January – Presentation at Pioneer Crop Production Clinic in Dumas, TX (2011-14)

January – Presentation at Pioneer Crop Production Clinic in Spearman, TX (2011-14)

January – Presentation High Plains Irrigation Conference by Harold Grall – Amarillo (2012, 13)


Figure 8: Moore County director, Harold Grall, explains the "200-12 Project" to corn growers from Iowa, Nebraska and Illinois.

January – Groundwater Management District Association - Austin (2013)

January – Site Visit by the Iowa Corn Growers Assoc. (2012)

February – Texas Alliance of Groundwater Districts (2013)

February – Ag Water Summit - Austin, TX (2013)

February - Published "200 Bushels of Corn on 12 inches of Irrigation Water Demonstration Project" and placed report on website (annually)

February – Presentation at Texas Panhandle Water Conservation Symposium – Amarillo (2012)

Figure 9: Growers gain insight during the 2010 Dalhart Field Day presented in cooperation with Pioneer Hybrid, Inc.

February – Booth at Dalhart Ag Appreciation Day (2012)

March – Perryton Corn Conference Presentation (2013)

March – Dumas Noon Lions Club meeting (200+) Membership (2011)

April – High Plains Water Management and Conservation: Data Workshop (2013)

April – Presentation at Perryton Lions Club (2012)

April – Presentation at United States Committee on Irrigation and Drainage Conference – Austin (2012)

May 7 – RFDTV "Out on the Land" Segment (2013)

May – TCEQ's Environmental Excellence Award Presentation – Austin (2012)

June – NRCS Video News Release on CIG Funding of "200-12 Project" (2012)

July – CBS Los Angeles Bureau Segment on national feed (2012)

July – Spearman Rotary Club (2011)

July - Sunray Lions Club (2011)

Figure 10: Growers and other stakeholders gather around to get details about the management of this "200-12" field in Moore County.

August - Presentation at Dumas Rotary Club (2012)

August - Hutchinson County Field Day in cooperation with Texas AgriLife – Morse, TX (annually)

August - Ochiltree County Field Day in cooperation with Texas AgriLife – Perryton, TX (annually)

August – Moore County Field Day in cooperation with Texas AgriLife – Dumas, TX (annually)

August – Sherman County Field Day in cooperation with Texas AgriLife – Stratford, TX (annually)

August –Booth at TAGD Texas Groundwater Summit – Austin (2012, 2013)

September – Cooperator Field Tours (2012)

September – Voice of America video and radio interview – International radio and web release (2011)

October 3 – Sherman County Study Club – Stratford (2013)

October 22 – PBS "This American Land" Segment Shoot (2013)

November – Presentation Perryton Lions Club (2012)

November – Amarillo Farm and Ranch Show (annually)

Figure 11: "200-12 Project" Lead, Leon New, explains the project to a CBS Network crew.

November – Commodities Symposium – Amarillo Farm and Ranch Show (2011)

November – Texas Alliance of Groundwater Districts – Austin (2011)

Conclusion

We learned that high efficiency LEPA center pivot irrigation systems are needed to help stretch available water and that crop residue remains essential. Irrigation systems must get more of the available water to the crop. Also, we learned that drought tolerant hybrids were commonly planted, mostly in May, and performed well. 2011 and 2012 delivered a clear message that rainfall is not what it once was. Overall, 2013 was an improved corn production year with more

rainfall and cooler temperatures, but beginning soil moisture was low following 2012. Over the course of the project, irrigation was reduced by 1,286.89 acre-feet (6.29 inches). By reducing current irrigation volumes by as little as three inches over the one million acres of irrigated cropland within the district, it is possible to save up to 250,000 acre-feet of groundwater per year and prolong the viability of irrigated agriculture in the area. Table 6 summarizes the water savings of the project.

Table 6: Total Water Savings

Year	Acreage	Total Irrigation (in.)	Total Irrigation (ac-ft)	Water Savings (in.)	Water Savings (ac-ft)
2010	270	11.30	254.20	7.89	177.50
2011 (1)	682	15.33	871.19	9.24	525.25
2012 (2)	819	16.02	1093.25	5.93	404.51
2013	686	18.08	1033.30	3.14	179.63
Total	**2457**	**15.88**	**3251.94**	**6.29**	**1286.89**

Notes: (1) In 2011, 3 of 9 producers harvested grain, 3 harvested silage, and 3 abandoned their field

(2) In 2012, 1 of 12 producers harvested silage

What We Learned

- Low energy precise application (LEPA) assisted in boosting yields verses other application types
- Later planting dates can reduce irrigation requirements due to increased time to receive rainfall
- Drought tolerant hybrids boosted yields in limited water situations
- Crop residue is essential to reduce water evaporation, increase water infiltration, and reduce wind erosion
- Growers must be conscious of the amount of irrigation applied to produce a certain yield, managing on a yield per inch of water basis
- More knowledge of pre-season and seasonal soil moisture levels will assist in the conservation of water
- Satellite crop imagery has potential as an additional management tool, but needs further development