Implementing Educational Components of the Arroyo Colorado Watershed Protection Plan

Texas Water Resources Institute TR-480
October 2014

Texas Water Resources Institute
make every drop count

T. Allen Berthold, Ashley Gregory
Texas Water Resources Institute

Implementing Educational Components of the Arroyo Colorado Watershed Protection Plan

Focused on Agricultural Nonpoint Source Pollution

Final Report

by

T. Allen Berthold, Ashley Gregory
Texas Water Resources Institute

TSSWCB Project 10-11

Texas Water Resources Institute Technical Report TR-480
October 2014
College Station, Texas

Partners:

Texas A&M AgriLife Extension Service

Texas Water Resources Institute

United States Department of Agriculture, Natural Resources Conservation Service

Texas State Soil and Water Conservation Board, Harlingen Regional Office

Southmost Soil and Water Conservation District #319

Hidalgo Soil and Water Conservation District #350

The Texas Water Resources Institute is part of the Texas A&M AgriLife Extension Service, Texas A&M AgriLife Research, and the College of Agriculture and Life Sciences at Texas A&M University.

Funding Provided through a Clean Water Act 319(h) Nonpoint Source Grant from the Texas State Soil and Water Conservation Board and the U.S. Environmental Protection Agency.

Executive Summary

The focus of Texas State Soil and Water Conservation Board (TSSWCB) Project 10-11, "*Implementing Educational Components of the Arroyo Colorado WPP Focused on Agricultural NPS Pollution*", was to continue efforts to alleviate impairments in the Arroyo Colorado watershed through educational programs and direct mailings targeted at controlling agricultural nonpoint source pollution. Texas Water Resources Institute (TWRI) and Texas AgriLife Extension Service (Extension) conducted educational programs within the three county area of the Arroyo Colorado watershed focused on best management practices (BMPs), nutrient management, and sources of financial and technical assistance. The continuation of these vital programs was made possible by funding from a Clean Water Act Section 319(h) grant from the Texas State Soil and Water Conservation Board (TSSWCB) and the U.S. Environmental Protection Agency (EPA).

This project began in 2010 and was a continued effort of previous agricultural education programs in the watershed. Extension carried on prior programming that highlighted water quality issues in the Arroyo Colorado with guidance on how the agricultural community could aid in reducing pollutants. This was done primarily by educating producers on BMPs such as nutrient and irrigation management as well as providing resources for producers on financial and technical assistance for implementing these practices. By working closely with the TSSWCB, U.S. Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) and the local Soil and Water Conservation Districts (SWCDs), resources were utilized efficiently and programs were current and relevant.

An evaluation conducted in the summer of 2013 identified educational needs and barriers to adopting practices of agricultural producers. Water quantity variables ranked amongst the top educational needs, specifically about the amount of irrigation water available and technologies that reduce the amount of water used during irrigation. Key barriers to adopting practices were related to economics where the initial cost of installing and cost share levels being too low were the primary barriers. Other educational needs and barriers were identified as well.

Over the four years of this project, 4,023 individuals were reached through attendance of educational programs, direct mailings, or participation in the annual soil testing campaign. Approximately 225 individuals submitted over 1,700 soil samples, representing 45,404 acres in the three county area.

Soil testing and agricultural education programs will continue to be a vital part of accomplishing the goals outlined in the Arroyo Colorado Watershed Protection Plan. Considering that the majority of the land within the watershed is under some type of agricultural production, these efforts will play an important role in keeping the agriculture community engaged and reaching new producers.

Table of Contents

List of Figures

List of Acronyms and Abbreviations

AC – Arroyo Colorado

ACWP - Arroyo Colorado Watershed Partnership

ACWPP - Arroyo Colorado Watershed Protection Plan

BMPs – best management practices

CEA – County Extension Agent

CEU – continuing education unit

DDE - Dichlorodiphenyldichloroethylene

DDT - Dichlorodiphenyltrichloroethane

DO – dissolved oxygen

EPA – U.S. Environmental Protection Agency

Extension – Texas A&M AgriLife Extension Service

EQIP – Environmental Quality Incentives Program

GPS – global positioning system

NRCS – U.S. Department of Agriculture, Natural Resources Conservation Service

PCB – Polychlorinated biphenyl

RGV – Rio Grande Valley

SWCD – Soil and Water Conservation District

TCEQ – Texas Commission on Environmental Quality

TMDL – Total Maximum Daily Load

TSSWCB – Texas State Soil and Water Conservation Board

TWRI – Texas Water Resources Institute

USDA – United States Department of Agriculture

WPP – watershed protection plan

WQMP – water quality management plan

Introduction

The Arroyo Colorado (AC) is a tributary of the Rio Grande River that at one time was part of a diverse and unique semi-tropical, coastal environment. Today, the AC hardly resembles what it once was with 95% of its natural habitat cleared for agricultural and urban development. Stream bank destabilization due to habitat loss and major modifications to the channel for navigation and flood water conveyance has degraded the AC to the point where it can no longer efficiently assimilate pollutants. The combination of these factors has led to a severely impaired body of water.

The Arroyo Colorado watershed is an area of approximately 706 square miles that encompasses portions of Hidalgo, Willacy and Cameron Counties. The Arroyo Colorado begins in Hidalgo County in the City of Mission flowing 90 miles across the Rio Grande Valley into the Lower Laguna Madre. The AC is classified as having two segments due to the difference in physical characteristics; segment 2202 is the freshwater portion that is primarily used as a floodway and for waste water conveyance for both urban and agricultural lands. Segment 2201 of the AC is tidally influenced and serves as an inland waterway for commercial barge traffic as well as a nursery and forage area for fish, shrimp and crab.

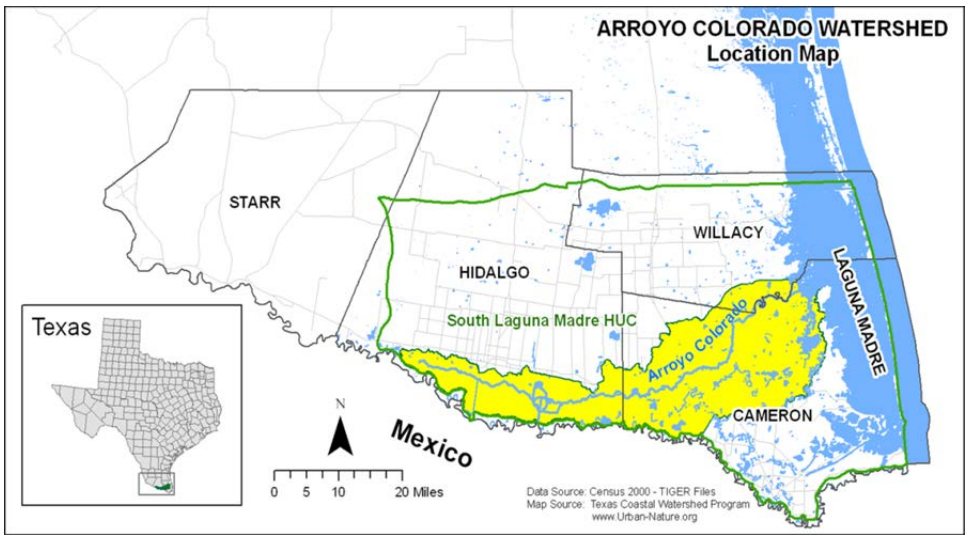


Figure 1. Arroyo Colorado Watershed

The AC watershed primarily consists of agricultural land where 333,000 acres are designated as agricultural land where cotton, grain sorghum, corn, sugar cane, citrus and a variety of vegetable crops are produced. In addition, there are at least 15 cities within the watershed that are rapidly growing and contributing to both urban point source and nonpoint source pollution. Flow in the AC is sustained by urban wastewater and stormwater runoff, irrigation and other agricultural return flows, as well as some base flow from groundwater. With the primary flows coming from either wastewater or some type of runoff, the water quality of the AC does not always meet water quality standards, which severely limits its use for municipal, industrial, recreational and irrigation purposes.

Both Segments of the AC have been on the Texas Integrated Report of Surface Water Quality (303d list) since 1996; as of 2012, Segment 2201 is listed for bacteria, DDE (breakdown product of DDT) in edible tissue, depressed dissolved oxygen, mercury in edible tissue and PCBs in edible tissue. Segment 2202 is listed for bacteria, mercury in edible tissue and PCBs in edible tissue. Since 1998, various efforts have been made to mitigate pollutant loads into the AC. A Total Maximum Daily Load study began in 1998, but due to inconclusive results, the Texas Commission on Environmental Quality (TCEQ) recommended further monitoring and modeling of the AC watershed. In 2003, the Arroyo Colorado Watershed Partnership (ACWP) was formed to help create a comprehensive plan to address the issues in the AC; the recommendations from the ACWP were used to create the Arroyo Colorado Watershed Protection Plan (ACWPP), which was published in 2007.

Agriculture contributes to nonpoint source pollution in the AC watershed, and due to the non-regulatory nature of controlling agricultural nonpoint source pollution, it is important to continue encouraging producers to voluntarily adopt recommended best management practices (BMPs) and implement conservation plans. Given that the AC continues to be listed as an impaired body of water, there is a clear need to continue these programs.

This project, which began in 2010, was a continuation of previous educational efforts in the AC watershed. The Extension Assistant worked with County Extension Agents (CEAs), local SWCDs, the TSSWCB and the USDA-NRCS to deliver relevant programs and demonstrations to encourage the adoption of BMPs that could improve producer operations and water quality in the AC. In addition to the programs, an annual soil testing campaign was held to encourage producers to utilize residual nutrients already present in the soil, which could not only save them money, but also reduce nutrient loading to the Arroyo Colorado.

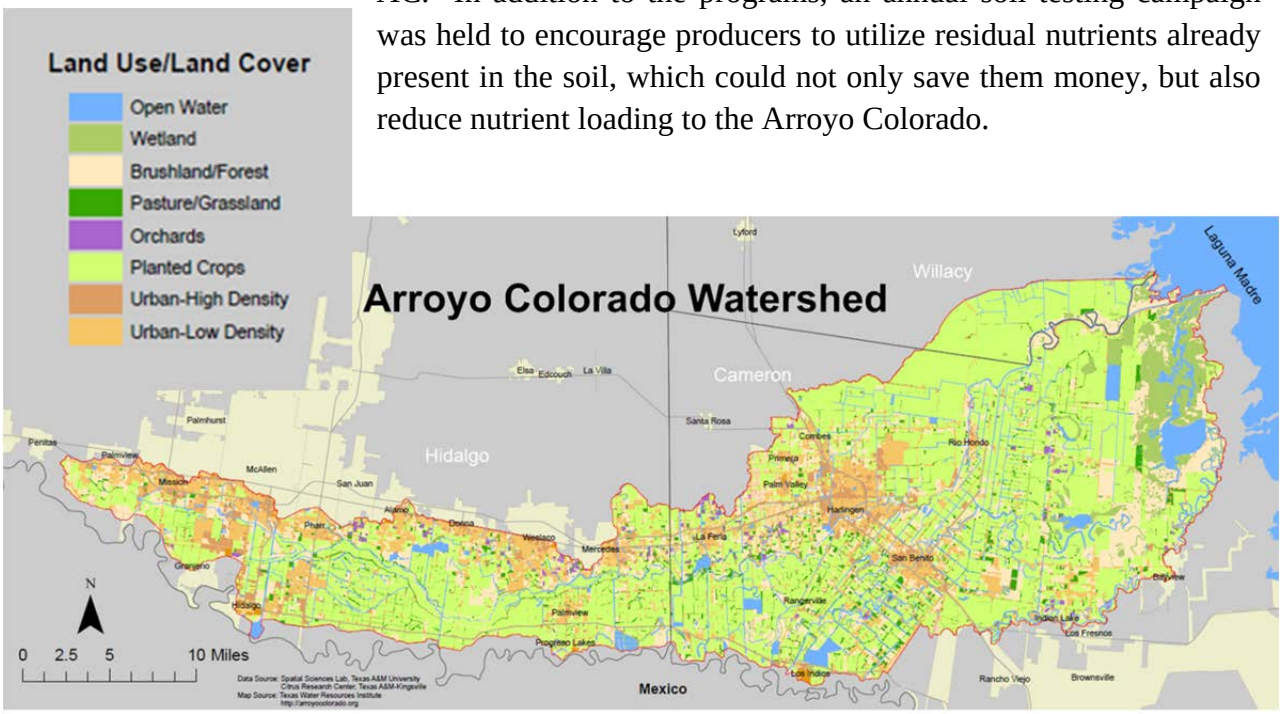


Figure 2. Arroyo Colorado Watershed Land Use/Land Cover Map

Objectives

This project began in October of 2010 with the goal of continuing educational programs for agricultural producers about nonpoint source pollution issues facing the AC and practices that could be implemented to help reduce nutrient and sediment loading into the AC. In order to encourage adoption of water quality improving BMPs, the project also highlighted associated programs that offer financial and technical assistance to producers. To better understand how to bolster the adoption of BMPs and develop appropriate programs, an evaluation was created to determine barriers for adopting more sustainable farming practices over conventional ones.

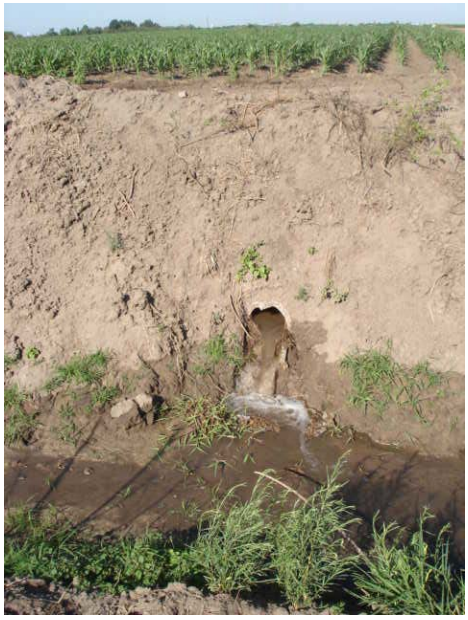


Figure 3. Irrigation return flows from a sub-surface drain flowing into a drainage canal

The Texas Water Resources Institute (TWRI) was tasked with handling the administration and coordination of the project, while an Extension Assistant was hired to carry out the project deliverables. The Extension Assistant worked with TWRI, CEAs, and local partners (NRCS, TSSWCB, SWCDs) to create relevant educational materials such as fact sheets and presentations to be used at educational programs. The Extension Assistant utilized the network of local partners to build upon existing programs and resources to host educational programs and events over the course of the project. The primary goal of the program was to encourage landowner adoption of BMPs through the participation in technical and financial assistance programs. Participation would improve landowner operations and protect the water quality in the AC.

Project Coordination

Throughout the project, TWRI and project partners regularly communicated to ensure that project tasks and deliverables were complete and consistent with the workplan as well as meeting what is outlined in the ACWPP. To facilitate this, the Extension Assistant served as the lead for the Arroyo Colorado Watershed Partnership Agricultural Issues Workgroup and participated in the Partnership's Habitat Workgroup and Steering Committee meetings to communicate agricultural activities as well as participate in various entities' meetings, which is outlined later in this document. Further, the Extension Assistant ensured that the project website, arroyocolorado.org, was continuously updated

Local Education Meetings

The primary purpose of this project was to alleviate agricultural NPS pollution in the AC. To do so, the Extension Assistant organized and hosted multiple programs and events that focused on

topics such as: raising awareness of agriculture NPS pollution in the AC, educating producers on the use of BMPs, promoting nutrient management and soil health, and encouraging voluntary adoption of conservation plans. As a result of the wide array of potential impacts to water quality, various programs, events, and direct mailings were developed ranging from pesticide safety training to building water conserving landscapes. Throughout the four years of this project, 4,023 individuals were reached through educational efforts directly related to the goals of this project. It is estimated that at least another 3,000 individuals were reached at larger, indirectly related events such as environmental expos, conferences, meetings, etc. Lastly, nearly 2,000 individuals were reached with direct mailings containing the Agricultural NPS in the Arroyo Colorado Watershed one-pager.

Figure 4. (Clockwise) Vendor booth, 2010 TX Irrigation Expo. Field tour, 2010 TX Irrigation Expo. Attendees of the 2011 TX Irrigation Expo at a pesticide safety training. Vendor booth, 2011 TX Irrigation Expo.

In the first two years of this project, an annual Irrigation Expo was held to display the latest irrigation technology and equipment. The Expos helped to present regional conservation efforts. Tours of demonstration sites with expert speakers were also offered. Both events were very successful and had an excellent line up of speakers and booths, which were widely received with over 150 people attending in 2010 and 200 people attending in 2011. Agendas from both Irrigation Expos can be found in Appendix C.

A study conducted as part of the TSSWCB #06-10 project (Best Management Practices and Water Quality Parameters of Selected Farms Located in the Arroyo Colorado Watershed) showed that in addition to nutrient management, reducing irrigation water runoff played a major role in preventing nutrient loading into the AC. Flood or furrow irrigation is the primary method used in this area and often results in irrigation water loss to deep percolation and runoff. One technology that can be used with this method of irrigation is the surge valve, and the Extension Assistant worked with the Texas Project for Ag Water Efficiency

and Rio Grande Regional Water Authority to promote a program called the Surge Valve Cooperative. Thanks to funding received from the Bureau of Reclamation, the Cooperative was able to provide surge valves to producers at a greatly reduced cost. The Extension Assistant worked with both groups to host several field days to educate producers on the benefits of surge valves and encourage them to adopt this BMP.

Figure 5. Participants at the RGV Ag Water Issues program held on August 20, 2014.

In addition to educational programs focusing on BMPs and nutrient management, the Extension Assistant chose to focus some programs on large topical issues such as water quality, availability, and conservation. For example, the Rio Grande Valley (RGV) Ag Water Issues Program looked at broader issues such as availability of irrigation water and regional projects working to increase irrigation efficiency and water conservation through the irrigation districts. A panel of irrigation district managers and local producers discussed issues facing the RGV, like the enormous task of improving a greatly inefficient and aging irrigation water delivery system.

The Extension Assistant forged a partnership with the Texas International Produce Association to collaborate on studying yield response in specialty crops when moved from furrow irrigation to drip irrigation. This irrigation method is already widely used on watermelons, but also showed yield increases in onions. Surveys conducted by the Texas International Produce Association, in association with this study, found that many producers were already switching onions over to drip irrigation in an effort to conserve water and improve yields. There is potential for other crops, but drip irrigation can be costly to install and is not always conducive to the current water delivery system. The Extension Assistant helped host two field days that were held in conjunction with this study.

Through collaborative efforts involving partners from NRCS, Farm Services Agency, and TSSWCB (who were always present to answer technical questions and offer assistance), various financial assistance workshops were held where the Water Quality Management Plan Program (WQMP) and Environmental Quality Improvement Program (EQIP) were promoted. Generally, this occurred through formal presentations or educational fact sheets, but as mentioned above, various field days were also an effective means of communicating. As a result of such efforts, various conservation plans (both through WQMP and EQIP) have been developed.

A list of educational programs and events that the Extension Assistant either hosted, helped organize or spoke at can be found in Appendix B. This list only includes programs where the

Extension Assistant spoke directly about the AC watershed and related activities. There were numerous other meetings, programs and events that the Extension Assistant attended and participated in.

Evaluation of Agricultural Producers

During the summer of 2013, an evaluation was conducted in an effort to identify the primary educational needs and barriers to adopting management practices. The evaluation was mailed to 1,137 individuals where 274 were completed and returned. Results regarding educational needs indicated that water quantity was the primary educational need and specifically, agricultural producers were interested in the amount of irrigation water available and specific practices that reduce the amount of irrigation water used. This is especially important to water quality because as mentioned above, reducing the amount of water applied to agricultural fields can reduce the amount of water coming off the field. Regarding barriers to adopting management practices, results indicated that economic barriers were the primary reasons for non-adoption, but specifically, the initial cost of installing and low incentive levels were the key barriers. Secondly, information and education was the next highest barrier to adopting practices where the lack of information about practice effectiveness and the lack of opportunities to see practices at demonstrations were high barriers. This project was able to alleviate some of these barriers by providing relevant information related to practices at field days; however, the results indicate that such programs should continue. More information about results can be identified in Appendix E.

Soil Testing Campaign

Since 2002, an annual soil testing campaign has been offered free of cost to agricultural producers in the Lower Rio Grande Valley to help them make educated decisions on nutrient application for their crops. Not only does this provide them with an opportunity to reduce fertilizer costs, but it helps to decrease nutrient losses into the AC. Originally the campaign was funded by USDA – Cooperative State Research, Education, and Extension Service and then by the Rio Grande Basin Initiative in Starr, Hidalgo, Willacy and Cameron Counties. From 2008 to present, the campaign has been funded by various grants awarded to TWRI by the TSSWCB. As those projects focused on the AC watershed, only counties within the AC watershed, Hidalgo, Cameron and Willacy Counties, could participate in the campaign.

As per this project, the soil testing campaign began in October and ran through the end of February. Soil sample bags and forms were available at the local County Extension Offices or at the Texas A&M AgriLife Extension Service District 12 Office in Weslaco. Once the soil samples were returned to those locations, they were shipped to the Texas A&M Soil, Water and Forage Testing Laboratory in College Station. In addition to the soil analysis, the project's Extension Assistant and County Extension Agents were available to demonstrate how to properly collect a soil sample and in some cases assisted in collecting samples. The free soil analysis was mailed directly to the producer, where they could then consult with County Extension Agents or representatives from NRCS or TSSWCB for further interpretation of those results.

From 2010 through 2014, there were four soil testing campaign seasons where 225 producers submitted 1,736 soil samples representing approximately 45,404 acres. This project marks years 10 through 13 that the soil testing campaign has been offered, and the data shows that producers are benefiting from the availability of this campaign. Through this project, it was concluded that the producers in the RGV may simply be better educated and are already applying the correct amount of nutrients. The soil testing campaign and associated educational programs have been effective in teaching producers about nutrient management and crop fertility needs. Of the producers that have participated in the campaign in past years, 41% seemed to have a good idea of the nutrient requirements for their crops and most had planned their fertilizer applications well; soil lab recommendations matched very closely with what they planned to apply. For producers who were new to the campaign or had not sampled their soil in the past 3 years (30%), soil lab recommendations were an average of 4 lbs/acre less than what producers had planned to apply. The remaining 29% of participants did not respond as to whether or not they had sampled their soil in the past 3 years. Although there were not big numbers in nutrient reductions, we can conclude that producers are only applying the supplemental nutrients required to grow their crops. The plants are using the majority of these nutrients, and they are not being lost in irrigation run off.

Figure 6. Arroyo Colorado Watershed Extension Assistant, Ashley Gregory, shows the tools used to collect soil samples.

The soil testing campaign was promoted each season with a press release in the local newspapers, flyers posted at cotton gins, feed and seed stores, hardware stores, and information sent via email contact lists and by word of mouth. Soil testing was encouraged at nutrient management programs, cost share programs and any other educational programs, where appropriate. A public service announcement was filmed both in English and Spanish for airing on local TV stations to publicize how soil testing can benefit the AC; both versions can be found at the following link: http://arroyocolorado.org/projects/completed-projects/public-service-announcements/.

Conclusions

This project was a success based on the amount of individuals reached, educational publications created, and information gathered. Continued education of agricultural NPS pollution will remain an important endeavor in the AC watershed, even after water quality begins to improve. The majority of the land in the AC watershed is comprised of some form of agriculture and because implementation of BMPs and conservation plans are voluntary, it will be necessary to keep promoting these practices along with technical and financial assistance. Key educational needs and barriers to adopting BMPs were identified where results indicated that financial and educational needs and barriers ranked amongst the top. The soil testing campaign has been a huge success in the past and continues to be highly utilized by producers. Since we know that nutrient and irrigation water management are two of the most impactful BMPs when it comes to reducing nutrient and sediment loading into the AC, agricultural education programs, along with soil testing, will continue to be vital to improving water quality in the AC.

During the course of this project, 4,023 individuals were reached through educational programs or events and another 2,000 through direct mailings, which raised awareness of the issues in the AC watershed. Their knowledge was increased on practices, technologies and programs that could help them improve their operation thereby affecting the overall health of the AC. Over the past 13 years, the soil testing campaign has remained a highly utilized program with 1,736 samples submitted during this project alone. This project supported existing TSSWCB programs by collaborating to host events and promoting their goal of implementing WQMPs; 38 plans have been written over the past four years. This project also worked closely with NRCS to advertise their programs and encouraged producers to seek technical and financial assistance with them as well.

The number of individuals reached through this project clearly shows that the agricultural community is interested in learning how they can help. Agriculture is such a large part of the AC watershed that we cannot move forward without the cooperation of the agricultural community. By working with producers, we will keep getting closer to the goals outlined in the ACWPP. However, we do know that there are barriers associated with adopting sustainable agricultural practices.

Appendix A – List of Educational Events, Descriptions, and # of Attendees

Date	Event	County	Description	# of Attendees
10/21/2010	Texas Irrigation Expo	Hidalgo	Present water conservation efforts in the RGV	40
10/22/2010	Texas Irrigation Expo	Hidalgo	Show case water conservation efforts in the RGV	35
2/10/2011	ACWP Steering Committee Meeting	Hidalgo	Update of Agriculture Issues in the ACW	18
4/5/2011	Pesticide Safety Training	Cameron, Hidalgo	Topics cover the following areas: General, IPM, Laws and Regs., Drift Minimization	30
4/12/2011	Sod Growers Meeting	Cameron, Hidalgo		22
4/21/2011	Master Gardener Class	Hidalgo		27
4/21/2011	Ag Producers Meeting	Hidalgo	BMPs and Cost Share Opportunities	18
5/4/2011	Pesticide Safety Training	Cameron, Hidalgo	Topics cover the following areas: General, IPM, Laws and Regs., Drift Minimization	21
5/11/2011	Tour of Cotton Trials	Cameron, Hidalgo	Dr. Gaylon Morgan, Extension Cotton Specialist toured cotton variety trials	78
6/2/2011	Sorghum Field Day	Cameron, Hidalgo, Willacy		86
6/30/2011	Corn/Soybean Field Day	Cameron, Hidalgo, Willacy		134
10/19/2011	Ag Issues Workgroup Meeting	Hidalgo	Cost Share Opportunities	20
10/31/2011	Texas Citrus Mutual and Texas Vegetable Association Meetings	Cameron, Hidalgo, Willacy	Soil Testing Campaign, Nutrient Management and WQMPs	26
11/1/2011	Cotton & Grain Producers Board Meeting	Cameron, Hidalgo, Willacy	Soil Testing Campaign, Nutrient Management and WQMPs	23
11/9/2011	Texas Irrigation Expo 2011	Cameron, Hidalgo, Willacy	Show case water conservation efforts in the RGV	100
11/10/2011	Texas Irrigation Expo 2011	Cameron, Hidalgo, Willacy	Show case water conservation efforts in the RGV	100
1/18/2012	Cotton and Grain Pre Plant Meeting	Cameron, Hidalgo, Willacy	Soil Testing Campaign, Nutrient Management and cost share programs	100
2/1/2012	La Feria Gin Co-op grower meeting	Cameron	BMPs and soil testing	15

4/19/2012	ACWP Ag Workgroup Meeting	Cameron, Hidalgo, Willacy	Cost Share Opportunities and soil campaign results	12
6/1/2012	Grain Sorghum/Sunflower Field Day	Hidalgo, Cameron	Ag NPS Pollution, BMPs and cost share opportunities	123
7/18/2012	IBWC LRGV Citizens Forum Board Meeting	Cameron, Hidalgo, Willacy	Arroyo Colorado Flood Control Project	37
7/24/2012	Rio Farms Field Day	Hidalgo	Cotton and Sesame Field Day- Soybean disease update	135
7/29/2012	Special IBWC Meeting	Starr	Concerned landowners/producers about possible flooding of acreage	53
8/14/2012	TSSWCB Local Board Meeting	Hidalgo	Board meeting and NRCS Producer financial incentives presentation	9
8/24/2012	Marketing Workshop	Hidalgo	Workshop for small acreage producers	33
9/13/2012	Sugarcane Field Day	Hidalgo	Sugar Cane & Mill update, Irrigation Water situation, Weather Outlook-Cropping Systems & Environmental Stresses-Drought-Field Tour	76
Total number of people reached directly from October 2010 to September 2012				**1451**
3/15/2013	Financial Opportunities for Your Farm and Ranch	Willacy	Soil Testing Campaign and Cost Share Programs	21
4/16/2013	Irrigation District Managers Meeting	Hidalgo	Presented on best management practices and cost share programs.	19
4/25/2013	ACC Ag Workgroup Meeting	Hidalgo	Presented on Ag NPS pollution, best management practices and cost share programs	12
7/1/2013	Personal Contact	Hidalgo	Sorghum Trial Harvest	5
7/18/2013	ACC Habitat Workgroup and Steering Committee Meetings	Hidalgo		17
7/24/2013	NRCS Local Work Group Meeting	Cameron	Gave update on ACC projects and goal	10
8/17/2013	Ranch and Wildlife Management Workshop	Cameron	Gave presentation on conserving water	20
8/29/2013	Leadership Advisory Board Meeting	Cameron	Gave update on ACC programs and goals	13
9/13/2013	Surge Valve Demonstration	Hidalgo	Talked about cost share programs and BMPs	15
9/17/2013	Surge Valve Training	Hidalgo	Attended discussed how this is a BMP that ties into water quality	8

10/2/2013	Rio Grande Regional Water Authority Meeting	Hidalgo	Attended meeting	25
10/17/2013	ACC Habitat Workgroup and Steering Committee Meetings	Hidalgo	Participated in meetings	15
10/14/2013	Surge Valve Demonstration	Hidalgo	Promoted the soil testing campaign and cost share programs	12
12/4/2013	NRCS Soil Health Field Day	Willacy	Gave a presentation on soil sampling and discussed the soil campaign	45
12/10/2013	Fike Farms Field Day	Hidalgo	Attended and networked with producers	30
12/19/2013	Raymondville SWCD Meeting	Willacy	Attended meeting and gave update on ACCW; discussed upcoming Cost Share Education program	10
1/16/2014	Annual Cotton and Grain Pre Plant Meeting	Hidalgo	Gave a presentation about the ACW and the soil testing campaign	120
1/17/2014	Personal Contact	Cameron	Visited La Feria and Progresso Cotton Gins to drop off fact sheets and soil sample forms and bags	7
1/23/2014	Personal Contact	Hidalgo and Willacy	Visited Rangerville, Lyford, Willacy, Frisbee/Bell, Ross, and RGV Cotton Gins to drop off fact sheets and soil sample forms and bags	18
2/13/2014	RGV Coastal Studies Expo	Hidalgo	Had a booth at the Expo, took the ACW model and did mini presentations for elementary school kids	200
2/20/2014	ACC Agriculture and Habitat Workgroups and Steering Committee Meetings	Hidalgo	Presented the draft of the ag section for ACWPP Phase II	30
2/21/2014	Annual Subtropical Agriculture and Environments Society meeting	Hidalgo	Attended meeting and was elected to the SAES board	100
2/25/2014	Farm Bill Meeting	Hidalgo	Attended a farm bill meeting at Rio Farms	120
3/7/2014	2014 RGV Water Summit	Hidalgo	Attended, networked	150
3/24/2014	TWDB Meeting	Cameron	Attended	75
4/8/2014	Farm Bill Meeting	Hidalgo	Participated in discussion about new farm bill	50
4/9/2014	Storm Water Conference	Cameron	Attended conference	200
4/22/2014	Rio Grande Basin Partnering Meeting	Cameron	Participated in round table discussion of Arroyo Projects that could possibly be supported by US Corps of Engineers	60

4/24/2014	Riparian Workshop	Hidalgo	Participated in the Riparian Workshop	15
4/26/2014	Vida Verde	Hidalgo	Had a booth with the ACW model	800
4/29/2014	Technical and Financial Assistance Program	Hidalgo	Hosted and gave a presentation	50
5/7/2014	NRCS Soil Health Program	Willacy	Attended meeting, personal contact with producers	15
5/8/2014	Onion/Watermelon Field Day	Hidalgo	Hosted field day focused on the economics of different types of irrigation in onions and watermelon	60
5/9/2014	Jr. Master Gardner Teacher Training	Hidalgo	Attended, networked and got ideas about trying to incorporate aspects of the ACW into the Jr. Master Gardner Program	28
5/22/2014	Habitat/Steering Committee Meetings	Hidalgo	Attended	35
6/11/2014	Fike Farms Field Day	Hidalgo	Attended and networked with producers	60
6/12/2014	UTPA Science Teachers Program	Hidalgo	Hosted elementary/middle school science teachers. Gave a presentation on the ACW.	22
6/19/2014	Sugar Cane Aphid Field Day	Hidalgo	Attended and networked with producers	80
Total number of people reached directly from February 2013 to September 2014				**2,572**
Total number of people reached directly throughout the course of the entire project				**4,023**

Appendix B – Educational Meeting Agendas

Agricultural Water Conservation Demonstration Initiative

The Texas Irrigation Expo is coordinated by Harlingen Irrigation District as part of the state's *Agricultural Water Conservation Demonstration Initiative*, which is funded through a grant from the Texas Water Development Board. Project partners and cooperators include:

AW Blair Engineering

Delta Lake Irrigation District

Harlingen Irrigation District

Texas AgriLife Extension

Texas AgriLife Extension-FARM Assist

Texas A&M University-Kingsville

Texas Water Development Board

USDA-Natural Resources Conservation Service

WaterPR

PLATINUM SPONSORS

AW BLAIR ENGINEERING

H & V Equipment Services, Inc.

Texas Irrigation Council

RGRWA RIO GRANDE REGIONAL WATER AUTHORITY

LRGV Water District Managers Association

GOLD SPONSORS

EAGLE AUTOMATION CORPORATION

mace ValleyMation

Tiger

SILVER SPONSORS

IRRIGATION FITTINGS INC.

FRESNO Valves & Castings, Inc.

JOHN DEERE WATER

SOILEAU INDUSTRIES

Lewis Electric Motors

BRONZE SPONSORS

LINE-X PROTECTIVE COATINGS

TruePoint Solutions

Texas Irrigation Expo | 201

December 9-10, 2011

McAllen Convention Center

Presented by the Harlingen Irrigation District as part of the Agricultural Water Conservation Demonstration Initiative. Funded in part by a grant from the Texas Water Development Board.

www.TexasIrrigationExpo.org

Program & Schedule

Thursday, December 8

6:00-8:00 pm Private Reception

Comments by Special Guests
Carlos Peña, P.E.
International Boundary & Water Commission
L'Oreal Stepney, P.E.
Texas Commission on Environmental Quality
Thomas Michalewicz, P.E.
U.S. Bureau of Reclamation
Honorable Eddie Lucio, Jr.
Texas State Senate

Presentation of Research Poster Awards
Sen. Lucio & Dr. Shad Nelson, TAMU-Kingsville

Award Winners:
James Fullingim, UT-Pan American
Lea Garcia, TAMU-Kingsville
Miguel Gomez, TAMU-Kingsville
Francisco Melgoza, TAMU-K Citrus Center
Carlos Valdez, Sharyland High School

Friday, December 9

CEU Schedule
Classes for TDA CEUs are being offered by the Texas AgriLife Extension Service as follows:

9:00-10:00 am	Pesticide Record Keeping
10:00-11:00 am	Pesticide Laws and Regulations
11:00 am-Noon	Crop Insect Management
1:00-2:00 pm	Update on Herbicides to Control Brush
2:00-3:00 pm	General Brush/Weed Control

The CEU "classroom" is located on the far left side of the Exhibit Hall.

AgriLIFE EXTENSION Texas A&M System

Friday, December 9

Main Stage Schedule
8:00-8:30 am
TWDB Conservation Initiatives in Ag Irrigation
Dr. Robert Mace, Texas Water Development Board

9:00-9:30 am
Installation of Rubicon Gates
Sonia Lambert, Cameron County Irrigation District #2

10:00-10:30 am
HID's Conservation Projects: Why They Are Important to You
Tom McLemore, Harlingen Irrigation District

10:30 am
Presentation of Blue Legacy Awards
Dr. Robert Mace, TWDB, on behalf of the Water Conservation Advisory Council

Award Winners:
D & D Farms
Gertson Farms
Schur Farms
North Plains Groundwater Conservation District

11:30 am-Noon: Lunches can be picked up in the back of the Exhibit Hall in advance of the keynote address. Please present lunch ticket.

Noon-12:30 pm
Lunch & **Keynote Address**: TDA Water Initiatives
Deputy Commissioner Drew DeBerry
Texas Department of Agriculture

1:00-1:30 pm
Saving Water in Citrus Production Through Irrigation Management
Dr. Shad Nelson, Texas A&M University-Kingsville

2:00-2:30 pm
Economics of Water Technologies in the LRGV
Mac Young, Texas AgriLife Extension Service

3:00-3:30 pm
Irrigating with Poly Pipe
Phil Tacker, Delta Plastics

4:00-4:30 pm
Drip Flood Sprinkler in Annual Crops and Grass
Dr. Juan Enciso, Texas A&M University System

5:00 pm
Exhibit Hall Closes

Saturday, December 10

Main Stage Schedule
9:00-9:30 am
Rainwater Harvesting Research
Brent Clayton, Texas AgriLife Extension Service

10:00-11:00 am
Catching Rainwater
Billy Kniffen, Texas AgriLife Extension Service

11:30 am-Noon
Water Thrifty Landscapes
Robert Vanderveer, Texas Master Gardeners

1:00 pm
Exhibit Hall Closes

Other Activities

Family Activity
Mobile Learning Barn
Presented by the Texas Farm Bureau
(Back of Exhibit Hall, near concessions)

Research Poster Winners
Research Posters on Display
View the winning research posters from this year's contest.

Both activities are ongoing throughout the Expo.

TEXAS A&M AGRILIFE EXTENSION

5 CEU's

CEU Workshop

Wednesday, February 20, 2013
Hoblitzelle Auditorium, A&M AgriLife Research & Extension Center, Weslaco
Registration at 8:00 a.m., class begins at 8:30 a.m., concludes at 3:00 p.m.
Fee: $8.00 per hour for 5 hour workshop, $10 per hour for partial credit
Pre-registration is not required, lunch will be on your own

This training is certified for 5 hours of continuing education for all private, commercial and non-commercial TDA license holders. It will meet all the CEU requirements for annual commercial and non-commercial license renewals.

Topics and Speakers

Range & Pasture Weed Management: What to Look for this Spring
Dr. Megan Clayton, Extension Range Specialist, Corpus Christi

Update on Pesticides for Row Crops
Dr. Raul Villanueva, Extension Entomologist, Weslaco

IPM in Commercial Citrus Production
Danielle Sekula, Extension IPM Agent, Weslaco

Lunch

Laws and Regulations
Brad Cowan, County Extension Agent- Agriculture, Hidalgo County

IPM in Commercial Onion Production
Dr. Juan Anciso, Extension Vegetable Specialist, Weslaco

For further information contact the Cameron County Extension Office at 361-8236 or the Hidalgo County Extension Office at 383-1026 or 800-638-8239. Proceeds from this event will be used to support Extension educational programs conducted in Hidalgo and Cameron Counties.

Persons with special needs are requested to call in advance so these may be addressed.

Financing Opportunities for Your Farm & Ranch Workshop

Agenda

Tuesday, March 5, 2013
Lyford, Texas
Location: Tucker's BBQ Lyford, Texas

10:30 AM	**Welcome & Introductions** Rolando Zamora, EA-CED, Cooperative Extension Program Omar Gonzalez, CEA-Ag, Texas A&M Agrilife Extension Service
10:35	**USDA Farm Updates/Micro Loan** Tacho Cavazos, County Executive Director, Willacy County Farm Service Agency Butch Lerma, USDA Farm Loan Manager
10:55	**Texas AgFinance, Micro Loan** Benito Garcia, Loan Officer, Texas AgFinance
11:10	**Checklist for Farm Loan Applications** Vidal Saenz, Extension Agent/Farm Advisor, Cooperative Extension Program
11:20	**NRCS Program Updates** Juan M. Pena, District Conservationist Willacy County Jessica J. Benavides, Soil Conservationist South Texas Region
11:35	**Texas Mexico Boarder Coalition, Farm Record Book Program** Adrian De Los Santos
11:45	**Community & Economic Development in Willacy County** Rolando Zamora, EA-Community & Economic Development, Cooperative Extension Program
11:50	**Texas A&M Agrilife Extension Service, Soil Campaign** Ashley Gregory, Extension Assistant-Texas Water Resources Institute
12:00	**Evaluations & Adjourn**
12:05	**Lunch sponsored by Texas AgFinance**

Hosted by:

"The Cooperative Extension Program serves people of all ages regardless of race, color, national origin, sex, sexual orientation, religion, disability, political beliefs, marital or family status. (Not all classes apply to all programs) Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.)should contact. Texas Cooperative Extension Office at 956-487-2306.

TEXAS A&M AGRILIFE EXTENSION

Fike Farms and Rio Farms, Inc.
Grain Sorghum and Corn Field Day

In Cooperation with Texas A&M AgriLife Extension Service, Texas Department of Agriculture and United States Department of Agriculture

Date: Wednesday, May 29, 2013

Time: 2:00 p.m. Start

Place: Fike Park, East of Edinburg

Directions: From HW 107 and FM 493, go 1.2 m west on HW 107, turn north on Skinner Road. Fike Park is ¼ Mile north on the west side of the road.

Program

Welcome/Sign In	Michael Fike
Tour Grain Sorghum & Corn Variety Test Plots	Seed Company Breeders & Reps
Comments from Local Grain Buyers & Market Updates	Brad Cowan County Agent
FSA Updates	Tacho Cavazos, FSA Willacy County Franco Trevino, FSA Hidalgo County
Crop Insect Update	Danielle Sekula IPM Agent

TDA and CCA CEU's will be provided.
Evening Meal at Fike Park.

USDA

RFI

TEXAS A&M AGRILIFE EXTENSION

Rio Farms, Inc.
Southernpea, Sunflower, Grain Sorghum, Guar, Corn
And Sesame Field Day

In Cooperation with T.A.M.A.L.E.S., USDA, FSA, & TDA

Date: Thursday June 6, 2013
Place: Rio Farms, Inc. Monte Alto
Time: 9:00 a.m. START

Program:

Welcome/Sign in	Dale Murden
Field Tour of Research and Demonstration Studies	
Southernpea	Raymond Taylor – Wax Company
Sunflower (Oil & Confectionary)	Brad Cowan
Grain Sorghum	Seed Company Reps Dr. Bill Rooney – TAMU
Guar	Clint Forbes – West Texas Guar
Corn	Dennis Pietsch – TAMALES
Sesame	Charles Stickler – Sesaco
Crop Disease & Insect IPM Discussion	Dr. Tom Isakeit, TAMALES Company & Crop Consultants
Sesame, Guar, & Grain Sorghum Yield Estimate Contests	Andy Scott
New Developments from Ag Industries	Field Day Sponsor's Reps
FSA Updates	Tacho Cavazos – Willacy County Franco Trevino – Hidalgo County County Director
TDA /CCA/CEU's will be provided	

USDA

"Beat the Heat" Native Landscape and Water Conservation Program

Agenda

8:30 – 9:00
Sign In/Welcome

~ ~ ~

9:00 – 9:40
40 Gallon Challenge
Dr. Diane Boellstorff
Assistant Professor and Extension
Water Resource Specialist

~ ~ ~

9:40 – 10:40
Rainwater Collection
Brent Clayton
Water Specialist
Clayton Water Management

~ ~ ~

10:40 – 10:50
Break

11:00 – 11:30
Why Use Native Plants?
Mike Heep
Native Plant Specialist
Heep Nursery

~ ~ ~

11:30 – 12:00
Keeping it Green with Less Water
Jeffery Kleypas, CCA
Braden Plant and Soil, LLC

~ ~ ~

12:00 – 12:45
Lunch

~ ~ ~

12:45 – 1:45
Native Landscape Plans
Melanie McDonald
Professional Landscape Designer
M Designs

Texas A&M AgriLife Extension

Texas Water Resources Institute
make every drop count

San Benito FY 2014
Program Development/ Local Work Group Meeting
July 24, 2013

Agenda

1. **AgriLife Extension Service overview – Mark Ponce**
2. **Call meeting to order (Southmost SWCD #319 director)**
3. **Sign in sheet**
4. **Discuss the role of the Local Work Group, (LWG) meeting, State Technical Advisory Committee, (STAC)**
5. **Review beginning farmer/rancher, socially disadvantaged farmer/rancher**
6. **Resource concerns and practices**
7. **Programs**
   - **a. EQIP**
   - **b. AWEP**
   - **c. WHIP**
   - **d. CSP**
   - **e. FRPP**
   - **f. GRP**
   - **g. WRP**
   - **h. CCPI**
8. **Ranking**
9. **Review FY- 2013 funding**
10. **Review and recommend resource concerns to be prioritized for use on our FY 2014 ranking/screening tool. (1st priority – thru 8th)**

Cropland

Irrigated		Dryland	
FY 2013	FY 2014	FY 2013	FY 2014
~~1.Water Quality~~	1. 2	1. Soil erosion	1. _____
~~2.Water Quantity~~	2. 4	2. Water quantity	2. _____
~~3.Soil Erosion~~	3. 1	3. Plant health	3. _____
~~4.Soil Quality~~	4. 3	4. Water quality	4. _____
5.Plant Health	5. 5	5. Energy	5. _____
6.Air Quality	6. 6	6. Air quality	6. _____
7.Energy	7. 7	7. Soil quality	7. _____
8.Animal Health	8. 8	8. Animal health	8. _____

NRCS

Surge Valve Demonstration

Texas A&M AgriLife Extension and Texas Water Resources Institute are hosting a field day to demonstrate surge valves in the field. Surge valves can reduce water use and water waste by up to 30%. The water advances faster to the lower end of the field and it distributes fertilizer more uniformly and closer to the soil surface, avoiding leaching of fertilizer. We'll discuss what it takes to set these up and keep them working properly.

When:
Friday, September 13th 2013
10:00 am – 12:00 pm

Where:
Texas A&M AgriLife Research and Extension
Annex Farm
9584 Mile 2 W (½ mile north of EXPY 83 on Mile 2 W),
Mercedes, TX 78596
956-968-5581

AGRONOMIC & SOIL HEALTH FIELD DAY

AGENDA

WEDNESDAY, DECEMBER 4, 2013

CCA Hours Offered

7:30 – 8:00	Registration
8:00 – 9:00	No Till/ Reduce Tillage – Nutrient Management *Bruce Henderson, NRCS Zone Agronomist*
9:00 – 10:00	Soil Health Demonstration *Willie Durham, NRCS State Agronomist*
10:00 – 10:15	Break
10:15 – 11:15	Utilizing Cover Crops and No Till to Promote Soil Health *Willie Durham, NRCS State Agronomist*
11:15 – 12:00	Variable Rate Fertilization *Kevin Wolfe, Helena*
12:00 – 12:15	Soil Sampling *Ashley Gregory, Texas AgriLife Extension Service*
12:15 – 12:45	Lunch – Sponsored by Helena
12:45 – 12:55	Outreach *Carlos Lago- Silva, UTPA Rural Program Director*
12:55 – 1:30	Company Representatives / Equipment Review

Thank You to our Sponsors

HELENA

UTPA
THE UNIVERSITY OF TEXAS PAN AMERICAN
Rural Enterprise Development

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Willacy Soil & Water Conservation District

USDA is an equal opportunity provider and employer.

20th Annual RGV

COTTON & GRAIN

PRE-PLANT CONFERENCE

& Annual Membership Meeting of the
Cotton and Grain Producers of the Lower Rio Grande Valley
Thursday, January 16, 2014

TEXAS A&M AGRILIFE EXTENSION

1914 2014 100 YEARS OF SERVICE IN HIDALGO COUNTY

Program Topics

RGV Boll Weevil Eradication Program: Progress Made, Challenges Ahead
Larry Smith, Program Director, Texas Boll Weevil Eradication Foundation, Abilene

Beltwide Proposal to Assist the Valley with Boll Weevil Eradication
Dr. Don Parker, IPM Coordinator, National Cotton Council, Memphis, TN

Cotton Varieties for the Valley for 2014
Dr. Gaylon Morgan, Extension Agronomist- Cotton, College Station

Chemical Termination of Cotton
Dr. Greta Schuster, Extension Plant Pathologist, Kingsville
Jacob Pekar, Graduate Student, TAMUK, Kingsville

Cotton Market Outlook for 2014
Dr. John Robinson, Extension Economist- Cotton Marketing, College Station

Grain Sorghum Market Outlook for 2014
Dr. Mark Welch, Extension Economist- Grain Marketing, College Station

Lunch & Other Meeting Expenses Sponsored by our Allied Industry Partners

Lunch Program: Annual Membership Meeting of the
Cotton and Grain Producers of the Lower Rio Grande Valley
Brian Jones, President • Dr. Webb Wallace, Executive Director

A New Threat? Sugarcane/Sorghum Aphid
Dr. Raul Villanueva, Extension Entomologist, Weslaco
Danielle Sekula, Extension IPM Agent, Weslaco

RGV Soil Testing Campaign
Ashley Gregory, Extension Assistant, Weslaco

New Developments from Industry
Industry Representatives

Thank you Sponsors!!

Albaugh • All-Tex Seed • Allenberg Cotton Co. • Americot • AmVac • Arysta LifeScience • B-H Genetics • BASF • Bayer Crop Science • Braden Plant & Soil • Cameron County Farm Bureau • Capital Farm Credit • Cheminova • Crop Production Services • CropGuard Insurance • Delta Plastics • Depot Crop Insurance • Dow AgriSciences/Phytogen • DuPont Crop Protection • Farmers Crop Insurance • FMC • Fred Traylor • Garcia Grain Trading • Gavilon • Gayland Ward Seed • Golden Acres • Gowan • Helena Chemical • Hi-Tech Irrigation • Hidalgo County Farm Bureau • MANA Crop Protection • Miller Chemical & Fertilizer • Monsanto • Netafim • Neuhaus and Company • Nichino America • Noble Cotton • Pioneer Equipment • Pioneer Seed • PCCA • Sanders • Seed Source Genetics • Seiver Implement • Sesaco • Sorghum Partners • South Texas Insurance Services • Southwest Agribusiness Consulting • State Farm Insurance • Syngenta • Terral Seed • Texas Crop Insurance • Texas Farm Credit • Texas Grain Sorghum Producers Assoc. • Triumph Seed • US Insurance Services • Valent • Valley Co-Op Oil Mill • Valley Ag Crop Insurance • Wadkins & Assoc Insurance Agency • Weaks Martin Implement • Wilbur-Ellis • Willacy County Farm Bureau

NRCS TEXAS OUTREACH INITIATIVE WORKSHOPS

Hosted by:

UTPA Rural Enterprise Development and Arroyo Colorado Conservancy

Conservation Farming: Financial and Technical Assistance

Tuesday, April 29th, 2014

Texas A&M AgriLife Research and Extension Center

2401 E. Business 83, Weslaco, Texas

Join us for a free program to learn about conservation practices and the programs that support them. Various agencies offer financial and technical assistance to implement practices such as land leveling and pipe line installation.

R.S.V.P.
Ashley Gregory
956.968.5581 or
ahgregory@ag.tamu.edu

AGENDA

9:00 AM	Welcome and Introductions
	Carlos Lago-Silva—Director of Rural Programs, UTPA–RED
9:10 AM	Overview of Issues in the Arroyo Colorado Watershed / TSSWCB Funding
	Ashley Gregory—Extension Assistant, ACC
	Ronnie Ramirez—Conservation Planner, TSSWCB
9:40 AM	Water Conservation Conference – Managing the Rio Grande Waters
	Erasmo Yarrito Jr.—Rio Grande Watermaster, TCEQ
10:10 AM	El Niño or 'La Nada': Will Drought Return This Year?
	Barry Goldsmith—Warning Coordination Meteorologist, NWS
10:40 AM	Surge Valve Cooperative and Narrow Border Irrigation
	Tom McLemore—Project Manager, TPAWE
11:10 AM	NRCS Financial and Technical Assistance Programs
	Raul Hinojosa—District Conservationist, USDA-NRCS
11:40 AM	TDA Marketing and Finance Programs
	Nelda Garza—Field Representative, TDA
12:00 PM	Sponsored Lunch
12:40 PM	FSA Microloans, Operating Loans, & Continuous CRP (Riparian Buffers)
	Arnulfo Lerma, Farm Loan Manager, USDA-FSA
	Cristobal Perez, County Executive Director, USDA-FSA
1:20 PM	Questions and Event Evaluation

Joint Watermelon & Onion Field Day

Texas A&M AgriLife Research | Extension

TEXAS International Produce Association

Texas Water Resources Institute
make every drop count

YOU ARE INVITED TO ATTEND THE JOINT WATERMELON AND ONION FIELD DAY.

Learn what experts have to say on topics such as disease management, insect management and irrigation studies.

- Free Breakfast
- 2 CEUs

May 8, 2014

8:00 am - 12 pm

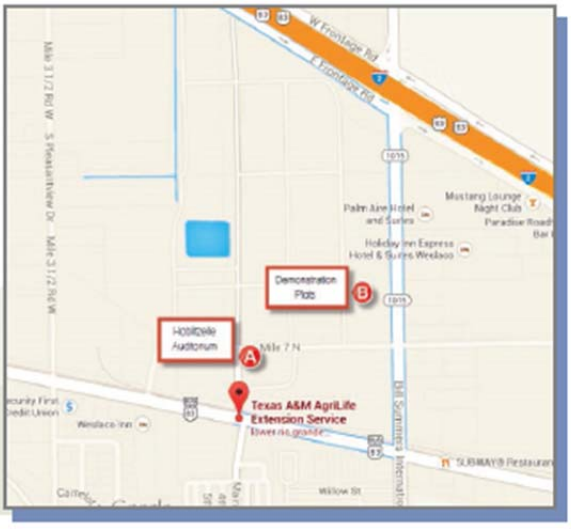
Hoblitzelle Auditorium
Texas AgriLife Research and Extension
2415 E. Hwy 83
Weslaco, TX 78596

Please Call or Email to Register:

Ashley Gregory
ahgregory@ag.tamu.edu
956-968-5581

AGENDA

Time	Topic	Speaker
8:00-9:00	Registration	
9:00-9:50	Integrated Disease Management on Onions and Watermelons 2014	Dr. Olefemi Alabi
9:50-10:40	Integrated Insect Management on Onions and Watermelons 2014	Dr. Raul Villanueva
10:40-11:10	Results of Irrigation Study on Onions	Dr. Juan Enciso
11:10-11:30	2013-14 RGV Onion and Watermelon Season Wrap-up	Rick Hernandez
11:30-12:00	Visit onion and watermelon plots	



August 20
2014

JOIN US FOR THE

RGV AGRICULTURE WATER CONSERVATION WORKSHOP

Register Today!

Call Ashley Gregory at 956-968-5581
or email ahgregory@ag.tamu.edu

HOBLITZELLE AUDITORIUM
TEXAS AGRILIFE RESEARCH & EXTENSION
2415 E. HWY 83, WESLACO, TX 78596

Want to Sponsor?

Call Hector Garza at 956-581-8632
or email hector.garza@texipa.org

AGENDA

Time	Topic	Speaker
8:00 am - 8:30 am	Registration	
8:35 am - 8:45 am	Introduction	Bret Erickson, Texas International Produce Association
8:45 am - 9:15 am	The current water situation in the Lower Rio Grande. Water demand and historic flows.	Pablo Mendrano / Erasmo Yarrito
9:15 am - 9:45 am	Weather update and prediction for the current season.	Barry Goldsmith, National Oceanic and Atmospheric Administration
9:45 am - 10:15 am	The Rio Grande Authority and emerging funding issues.	Joe Barrera, Rio Grande Regional Water Authority
10:15 am - 10:30 am	Break	
10:30 am - 11:00 am	Irrigation Water Conservation, tools for irrigation management and watermelons experiments results	Dr. Juan Enciso
11:00 am - 11:30 am	Water Economics	Dr. Luis Ribera
11:30 am - 12:00 pm	Humic Acids: Role in moisture management	Dr. Mir Seyedbagheri
12:00 pm - 1:00 pm	Lunch	
1:00 pm - 1:45 pm	Irrigation Districts and On Farm Water Conservation: Incentives for water conservation and irrigation districts ideas for water conservation.	Panel: Wayne Halbert, Harlingen Irrigation District. Troy Allen, Delta Lake Irrigation District , Dale Murden, Rio Farms, Joe Hinojosa, Santa Cruz Irrigation Dist.
1:45 pm - 2:15 pm	Managing Soil Moisture with Cover Crops	Bruce Henderson, Zone Agronomist - NRCS Corpus Christi
2:15 pm - 2:30 pm	Arroyo Colorado Watershed and Cost Share Opportunities	Ashley Gregory

SPONSORS:

Texas A&M AgriLife Research | Extension

TEXAS International Produce Association

Texas Water Resources Institute — make every drop count

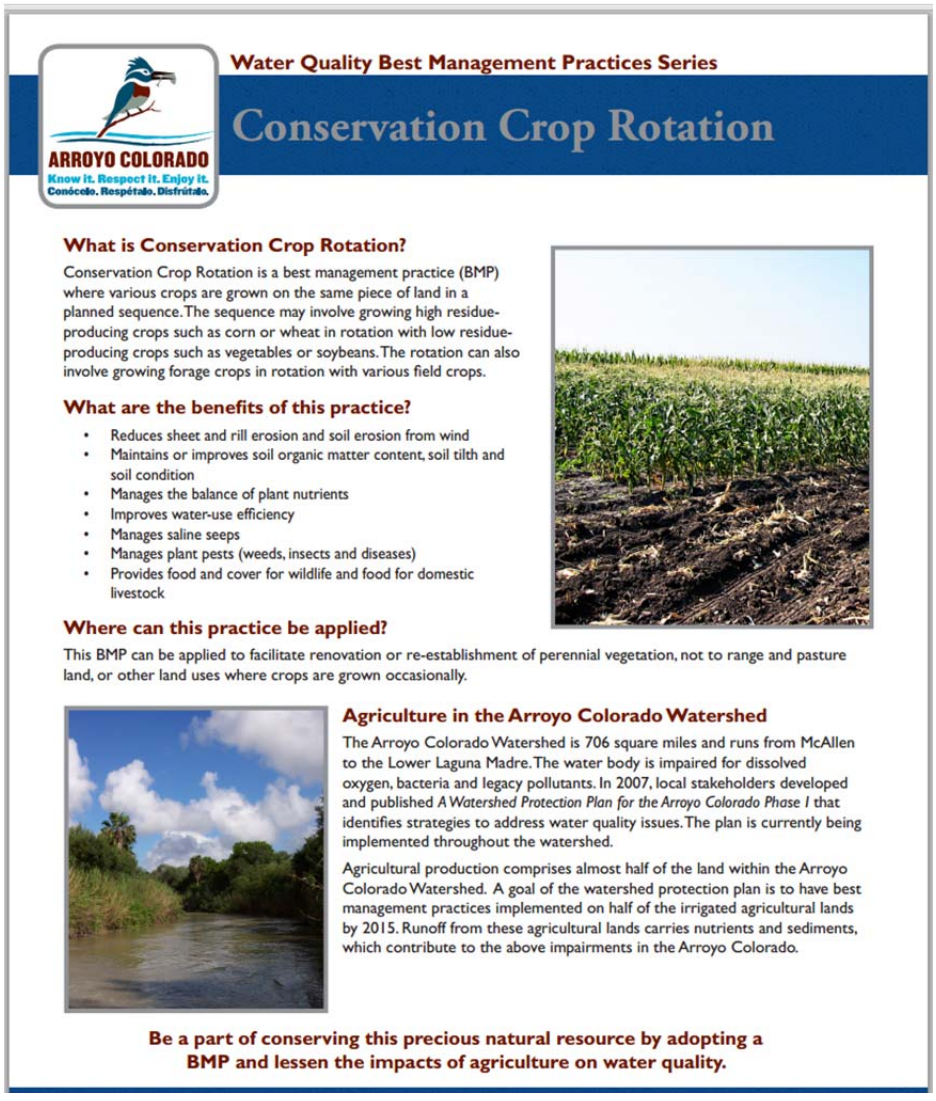
United States Department of Agriculture NRCS Natural Resources Conservation Service

Appendix C – Fact Sheets Developed Throughout the Project

The following fact sheets were also created:

- Filter Strips,
- Forage Harvest Management,
- Irrigation Land Leveling, Irrigation Management,
- Irrigation Polypipe, Irrigation Sprinkler System,
- Irrigation Storage Reservoir, Irrigation Water Management,
- Micro-irrigation Systems,
- Nutrient Management,
- Pest Management,
- Prescribed Grazing,
- Residue Management,
- Surface and Subsurface Irrigation,
- Surface Roughening,
- Tailwater Recovery System,
- Project fact sheet,
- Investigation of Select Drainage Ditches in the Arroyo Colorado Watershed,
- EM-113: Best Management Practices (BMPs) and Water Quality Parameters of Selected Farms Located in the Arroyo Colorado Watershed, and Agricultural NPS in the Arroyo Colorado Watershed

These publications can be at the following link: http://arroyocolorado.org/publications/.



ARROYO COLORADO
Know it. Respect it. Enjoy it.
Conócelo. Respétalo. Disfrútalo.

Water Quality Best Management Practices Series

Conservation Crop Rotation

What is Conservation Crop Rotation?

Conservation Crop Rotation is a best management practice (BMP) where various crops are grown on the same piece of land in a planned sequence. The sequence may involve growing high residue-producing crops such as corn or wheat in rotation with low residue-producing crops such as vegetables or soybeans. The rotation can also involve growing forage crops in rotation with various field crops.

What are the benefits of this practice?

- Reduces sheet and rill erosion and soil erosion from wind
- Maintains or improves soil organic matter content, soil tilth and soil condition
- Manages the balance of plant nutrients
- Improves water-use efficiency
- Manages saline seeps
- Manages plant pests (weeds, insects and diseases)
- Provides food and cover for wildlife and food for domestic livestock

Where can this practice be applied?

This BMP can be applied to facilitate renovation or re-establishment of perennial vegetation, not to range and pasture land, or other land uses where crops are grown occasionally.

Agriculture in the Arroyo Colorado Watershed

The Arroyo Colorado Watershed is 706 square miles and runs from McAllen to the Lower Laguna Madre. The water body is impaired for dissolved oxygen, bacteria and legacy pollutants. In 2007, local stakeholders developed and published *A Watershed Protection Plan for the Arroyo Colorado Phase I* that identifies strategies to address water quality issues. The plan is currently being implemented throughout the watershed.

Agricultural production comprises almost half of the land within the Arroyo Colorado Watershed. A goal of the watershed protection plan is to have best management practices implemented on half of the irrigated agricultural lands by 2015. Runoff from these agricultural lands carries nutrients and sediments, which contribute to the above impairments in the Arroyo Colorado.

Be a part of conserving this precious natural resource by adopting a BMP and lessen the impacts of agriculture on water quality.

AgriLIFE RESEARCH & EXTENSION
Texas A&M System

TEXAS A&M UNIVERSITY

arroyo colorado watershed protection

arroyocolorado.org

ARROYO COLORADO
Know it. Respect it. Enjoy it.
Conócelo. Respétalo. Disfrútalo.

The Arroyo Colorado, an ancient channel of the Rio Grande, flows 90 miles through Hidalgo, Cameron and Willacy counties in the Lower Rio Grande Valley of Texas. Water flow in the Arroyo Colorado is sustained by wastewater discharges, agricultural irrigation return flows, urban runoff and base flows from shallow groundwater. Elevated levels of fecal coliform bacteria and low dissolved oxygen have severely impacted recreational use of the lower Arroyo Colorado for fishing and swimming. In 2002, the Texas Commission on Environmental Quality (TCEQ) determined in a Total Maximum Daily Load study that a 90 percent reduction of nutrients and biochemical oxygen demand was needed to achieve healthy waters.

The Arroyo Colorado Watershed Partnership (ACWP) was established to help restore the watershed, and in 2007, the partnership published the Arroyo Colorado Watershed Protection Plan (AC WPP) that identified and addressed impairments and concerns in the watershed.

Since 2007, the Texas Water Resources Institute (TWRI) has coordinated the Arroyo Colorado program working closely with the ACWP, TCEQ and Texas State Soil and Water Conservation Board (TSSWCB) to implement projects to improve water quality of the Arroyo Colorado.

Completed Projects

- Education of Best Management Practices in the Arroyo Colorado
- Arroyo Integrated Farm Management Program
- Pesticide Education in the Coastal Zone of the Arroyo Colorado
- Public Service Announcements for the Arroyo Colorado Watershed
- Monitoring of Arroyo Colorado Wastewater Treatment Plants
- SWAT Modeling Simulation of the Arroyo Colorado Watershed
- Arroyo Colorado Watershed Protection Plan Implementation
- Enhancing Water Quality and Dredged Material for the Port of Harlingen (Phase I)
- Arroyo Colorado Agricultural Nonpoint Source Assessment

TWRI is currently coordinating three projects directed toward achieving the goals set in the AC WPP and updating the plan. The updated AC WPP will guide the implementation efforts in the watershed from 2015 into the future.

Cost-Share Education

- Continue education programs and enhance coordination of outreach and education of TSSWCB projects
- Increase the adoption rate of best management practices and water quality management plans by producers
- Reach producers that have not yet participated in technical and financial assistance programs in the Arroyo Colorado watershed

twri.tamu.edu

texas water resources institute

arroyo colorado watershed protection

Sustainability of the ACWP and Continued Implementation of the AC WPP

- Successfully continue implementation of the AC WPP by maintaining local steering committee and work group support and infrastructure
- Assess the increase in local stakeholder knowledge of watershed functions
- Implement tasks and goals outlined in the AC WPP
- Develop a sustainable program to support the AC WPP

Update of the AC WPP

- Review original AC WPP to identify data gaps and emerging issues in the watershed. Once identified, the data gaps and emerging issues will be addressed by incorporating them into AC WPP update.
- Complete SWAT, EDFC & WASP models with the resulting loading reductions incorporated into AC WPP update

Projects Accomplishments

- Projects have resulted in completion of 75 percent of the goals set in the AC WPP.
- Agricultural producers have adopted best management practices resulting in 109,188 acres under water quality management plans.
- Ten Wastewater Treatment Plants (WWTPs) have completed construction on upgrades/expansion to the WWTP infrastructure.
- Three cities, La Feria, San Juan and San Benito, have installed constructed wetlands at their respective WWTP to act as polishing ponds to treat the effluent before entering the Arroyo.
- Twenty-two *colonias*, 2,629 connections and more than 175 residents have been connected to central wastewater systems.
- More than 45,000 individuals have viewed the watershed demonstration model.
- Approximately 7,000 agriculture producers have attended educational meetings and workshops.
- The annual soil testing campaigns, partly funded through an ACWP project, have educated more than 6,200 producers and collected almost 3,900 soil samples.

Collaborators

- Arroyo Colorado Watershed Partnership
- Texas AgriLife Extension Service
- Texas AgriLife Research
- Texas Water Resources Institute
- Texas A&M University – Kingsville
- Texas A&M University Spatial Sciences Laboratory
- USDA Natural Resources Conservation Service
- University of Texas at Brownsville
- University of Texas at Arlington
- Allen Plummer and Associates

Funding Agencies

- Texas State Soil and Water Conservation Board
- Texas Commission on Environmental Quality
- Texas General Land Office
- U.S. Environmental Protection Agency

Texas Water Resources Institute
make every drop count

Texas Water Resources Institute
1500 Research Parkway, Suite 110, 2260 TAMU
College Station, TX 77843-2260
979.845.1851
twri@tamu.edu
4/2012

Investigation of Select Drainage Ditches in the Arroyo Colorado Watershed

ARROYO COLORADO
Know it. Respect it. Enjoy it.
Conócelo. Respétalo. Disfrútalo.

Agriculture in the Arroyo Colorado Watershed

Agriculture in the Arroyo Colorado watershed has been known to contribute to the current impairments in the Arroyo Colorado. As a result, demonstration projects showing the effectiveness of best management practices (BMPs) have been occurring since 2006 to better measure progress of meeting the Arroyo Colorado Watershed Protection Plan goals. An important component of those goals is to evaluate and quantify the nature and extent of nutrient loadings from agricultural activities in the region. This information is fundamental to promote BMPs and foster sustainable agricultural activities.

Agricultural Impacts to the Watershed and Mitigation Approaches

Agricultural nonpoint source (NPS) runoff has been identified as responsible for high levels of the suspended sediment, biological oxygen demand (BOD), nitrate, ammonia, and phosphate load in the Arroyo Colorado. To address this, the Arroyo Colorado Agricultural Issues Workgroup was formed in December 2003 to develop a strategy. The strategy encourages voluntary adoption of BMPs to reduce suspended sediment levels resulting from cropland erosion, BOD (oxygen demanding organic material) from runoff of crop residue, and nitrogen and phosphorus fertilizer runoff from irrigated cropland fields.

Objective of Project

As most agricultural runoff is carried to the Arroyo Colorado River through the drainage ditches, quantifying nutrient dynamics in the drainage ditches is of paramount importance. Therefore, focus of the project was to characterize the use of drainage ditches to remove excess nutrients in runoff water received from agricultural fields. Four representative drainage ditches were selected for extensive monitoring with two located in Cameron County and two in Hidalgo County. Additionally, this study was paired with a separate field study to assess edge-of-field characteristics with regard to irrigation runoff water quality from six different fields and various crops. Results from that study can be found in *Evaluation of BMPs to Reduce NPS Pollution at the Farm Level*, Enciso et al., 2011 (TR-423 available at twri.tamu.edu).

Results

The comparison of concentrations observed in agricultural edge-of-field runoff leaving the farms, and those in the drainage ditches highlight the reduction capabilities of the drainage ditches, particularly with regards to phosphorus compounds. It was observed that the concentration of both phosphorus and nitrogen compounds are higher in the runoff water leaving the edge-of-field than what is observed in drainage ditch flows. The drainage ditches effectively reduced forms of nitrogen (total Kjeldhal nitrogen and ammonia nitrogen), but the removal of oxidized forms of nitrogen (nitrate-nitrogen) was linked to the hydraulic characteristics of the ditches. It should be noted that during this study, the Arroyo Colorado Watershed experienced the effects of several major storms, including Hurricane Dolly and Tropical Storm Ike, and one of the most severe droughts in recent history that spanned the study period of 2009–2011. These meteorological events contributed to extreme values and high variability in the observed flow and water quality.

Investigation of Select Drainage Ditches in the Arroyo Colorado Watershed

Overall, drainage ditches help attenuate initial loadings of direct runoff from the fields and lead to a more uniform nutrient loading that is spread out over a larger period of time. Therefore, drainage ditches can act as both nutrient sources and sinks. Results also implied that dissolved oxygen in the ditches are controlled by climate (temperature) and any additional mixing associated with increased flows are unlikely to enhance re-aeration in the ditches.

Recommendations

Proper management of land (i.e. before entering the drainage system) as well as maintenance and management of ditches are necessary to ensure that the pollutant loadings are minimized and the ditches facilitate nutrient removal and or storage in a sustainable manner. Deepening certain sections of the ditch (where possible and feasible) can help improve nitrogen removal capabilities. Additionally, biomass removal during the months of June–October could be beneficial for mitigating both nitrogen and phosphorus loadings within the ditches. This removal will also provide for new vegetative growth which facilitates additional nutrient removal capabilities.

Contacts

Jaime Flores
Arroyo Colorado
Watershed Coordinator
Texas A&M AgriLife Research
2415 E Highway 83
Weslaco, TX 78596-8344
956.968.5581
jjflores@ag.tamu.edu

Ashley Gregory
Extension Assistant
Texas A&M AgriLife Extension Service
2401 E Highway 83
Weslaco, TX 78596-8344
956.969.5615
ashley.gregory@agnet.tamu.edu

Texas Water Resources Institute

TSSWCB

Texas Water Resources Institute
1500 Research Parkway, Suite 110
2118 TAMU
College Station, TX 77843-2118
979.845.1851
twri.tamu.edu

arroyocolorado.org

ARROYO COLORADO
Know it. Respect it. Enjoy it.
Conócelo. Respétalo. Disfrútalo.

Best Management Practices (BMPs) and Water Quality Parameters of Selected Farms Located in the Arroyo Colorado Watershed

Agriculture in the Arroyo Colorado Watershed

Excess water from various landscape activities in the Lower Rio Grande Valley are drained through the Arroyo Colorado eventually emptying into the lower Laguna Madre. The Laguna Atascosa National Wildlife Refuge and several county and city parks are located within the Arroyo Colorado watershed. The watershed is also the habitat of several semi-tropical plants and animal species. The Arroyo Colorado also boasts many recreational opportunities and attracts a large number of tourists annually. Agriculture, municipal and industrial activities are all contributors to water quality issues and impairments in the Arroyo Colorado watershed. The main concern coming from agriculture are chemicals such as fertilizers and pesticides that can be carried with the irrigation water through runoff and deep percolation. Agricultural producers can improve the water quality of the Arroyo Colorado by implementing best management practices (BMPs) that reduce nonpoint source (NPS) pollution from agricultural lands. Several demonstrations, one further described below, have been developed since 2006 to characterize the water quality of irrigation and runoff water and to evaluate the effectiveness of BMPs on water quality at the field and sub-watershed level. These activities have been conducted in an effort to implement the Arroyo Colorado Watershed Protection Plan and achieve its goals of reducing pollution from various sources, one of those being agriculture.

Objectives

One of the main sources of pollution are the nutrient loadings from agricultural runoff and leachates; therefore, a study focused on identifying the effect of agricultural management practices on NPS pollution from surface irrigated farms in the Arroyo Colorado watershed was initiated. The objective of the study was to obtain water quality information (parameters including: total dissolved solids, nitrates and nitrites, orthophosphate phosphorus, total phosphorus, and total Kjeldahl nitrogen) of irrigation water runoff and groundwater in six agricultural fields during the 2009 and 2010 growing seasons.

BMPs Implemented at Demonstration Sites

- Crop rotation
- Crop residue management
- Nutrient Management
- Pest Management
- Irrigation Land Leveling
- Irrigation Management
- Irrigation with poly-pipe
- Subsurface drainage
- Vegetation filter strips

Figure 1: Irrigation poly pipe utilized during an irrigation event

AgriLIFE RESEARCH & EXTENSION
Texas A&M System

arroyocolorado.org

TEXAS A&M UNIVERSITY

Best Management Practices (BMPs) and Water Quality Parameters of Selected Farms located in the Arroyo Colorado Watershed

Results

The predominant irrigation system in the Lower Rio Grande Valley is surface irrigation. The primary BMPs adopted by irrigating farmers in the Arroyo Colorado watershed are conservation crop rotation, irrigation land leveling, the use of poly-pipe and nutrient management. During this project only one site had filter strips at the lower end of the rows which received irrigation runoff. The main results of this study are listed below.

1. The results indicated that the irrigation water already contained high concentrations of nitrates, nitrites, orthophosphates, total phosphorus and total Kjeldahl nitrogen. Also, these concentrations varied from irrigation to irrigation.
2. The gains of nitrates, nitrites and total Kjeldahl nitrogen loadings from the fields were small. The activity that resulted in the highest influence on nutrient loadings was the amount of runoff. This could be reduced through improved irrigation management.
3. Nutrient loadings due to orthophosphates and total phosphorus were extremely low for all sites during both years, and these loadings were also influenced by the amount of runoff. High total dissolved solids could have resulted from higher furrow flow-rates that produce increased erosion and transport of sediments. These higher flow rates also result in higher nutrient loadings of orthophosphates and total phosphorus. The use of poly-pipe can reduce erosion, facilitate irrigation management and may have an influence on orthophosphates and total phosphorus.
4. The nutrient values within groundwater fluctuated from year to year and from irrigation to irrigation, but they were generally low. The few sites that had nutrient management implemented as a BMP were the sites that had some of the lowest nutrient values in groundwater.

Figure 2: Runoff resulting from an irrigation event being measured.

Recommendations

Producers can implement multiple BMPs to protect the water quality of the Arroyo Colorado. The combination of multiple practices can create a greater impact of nutrient reductions to the Arroyo Colorado. Some practices such as land leveling with some grade and the use of poly-pipe facilitate irrigation management and thus, have an impact on improving yields and profits. The two BMPs that reduced nutrient runoff the most were nutrient management and irrigation management. Nutrient management typically consists of applying fertilizer at a specific rate according to a soil analysis test. Irrigation management includes controlling the total amount of water applied to the land focusing on using non-erosive flow-rates, thereby reducing runoff.

This project was funded by a Clean Water Act §319(h) grant through the United States Environmental Protection Agency administered by the Texas State Soil and Water Conservation Board.

Texas Water Resources Institute
make every drop count

TSSWCB

Texas Water Resources Institute EM-113

arroyocolorado.org

Agricultural Nonpoint Source Pollution in the Arroyo Colorado Watershed

Agriculture in the Arroyo Colorado Watershed

The Arroyo Colorado Watershed, a 706-square-mile area, runs from McAllen to the Lower Laguna Madre and is impaired for dissolved oxygen, bacteria and legacy pollutants. In 2007, local stakeholders developed and published "A Watershed Protection Plan for the Arroyo Colorado Phase I," which identifies strategies to address water quality issues. Those strategies are currently being implemented throughout the watershed.

Agricultural production comprises approximately 314,000 acres within the Arroyo Colorado Watershed. Agricultural irrigation and rainfall runoff, commonly referred as agricultural nonpoint source pollution (NPS), contains sediment, nutrients, crop organic residue and other foreign materials. Agricultural runoff drains into a series of drainage canals that ultimately lead to the Arroyo Colorado, which eventually empties into the Lower Laguna Madre. Agricultural NPS pollution contributes to the impairment of certain segments of the Arroyo Colorado. Farmers are implementing best management practices (BMPs), which have proven to improve soil health and drainage water quality, thereby reducing the negative impact of agricultural runoff into the Arroyo Colorado.

Nonpoint Source Pollution Mitigation Opportunities

Several federal and state agencies offer financial incentive programs for agricultural producers, which assist producers in implementating and constructing these practices and structures that improve not only the cropland and crop yield potential, but also drainage water quality. Many of these agencies also provide technical assistance needed to make the proper decisions about the combination of conservation practices to be implemented on the land based on its use.

Many BMPs, such as land leveling, soil fertility testing, nutrient management, improved irrigation management, and others listed in the Field Office Technical Guide (FOTG), are used by producers to mitigate possible pollution impacts in the Arroyo Colorado. Produced by the USDA Natural Resources Conservation Service, the FOTG contains technical information about conservation as it relates to soil and water, and it serves as a scientific reference in the adoption of BMPs for the local area.

Detailed information about agricultural nonpoint source pollution in the Arroyo Colorado Watershed and other programs and projects can be found by visiting the following partner websites.

Collaborators

- Arroyo Colorado Watershed Partnership
  arroyocolorado.org
- Texas AgriLife Extension Service
  agrilifeextension.tamu.edu
- Texas AgriLife Research
  agriliferesearch.tamu.edu
- Texas Water Resources Institute
  twri.tamu.edu

Project Funding Agencies

- Texas State Soil and Water Conservation Board
  tsswcb.texas.gov
- Texas Commission on Environmental Quality
  tceq.state.tx.us
- U.S. Environmental Protection Agency
  epa.gov

arroyocolorado.org

Appendix D – Press Releases Developed Throughout the Project

Texas Irrigation Expo to focus on water conservation

Logan Hawkes

Dec 4, 2011

- Texas Irrigation Expo set to get underway Dec. 9–10 at the McAllen Convention Center.
- Producers must learn to employ water more efficiently and must be willing to embrace new technologies to cope with the growing demand on resources.
- Many rural homes and barns still have old cistern tanks and collection systems in place as they were widely used across the region over the last 200 years.

Planning for the water needs of 2013 will be the primary topic this week when producers, water district planners and representatives of agriculture support industries gather for the 2011 Texas Irrigation Expo set to get underway Dec. 9-10 at the McAllen Convention Center.

Dr. Juan Enciso, a Texas AgriLife Research irrigation engineer in Weslaco, says the water squeeze could hit water districts hard in 2013 as a result of another potentially dry 2012, and he says water conservation is an important issue for landowners and homeowners alike. He says the Expo is designed to educate and inspire producers and the general public to take an active role in water conservation efforts. A full schedule of special presentations is being offered and the latest in irrigation technologies will be discussed and demonstrated at a number of exhibits and special programs at the Expo.

"There is no silver bullet when it comes to solving water problems and it is difficult to get ag producers, homeowners and industry to embrace change. But conservation of our natural resources is our best strategy if we don't want to find ourselves in a position of being out of water," says Dr. Robert Mace, deputy executive administrator of the Texas Water Development Board. Mace is scheduled to open the Expo with a presentation about the latest conservation initiatives in Texas.

He says producers must learn to employ water more efficiently and must be willing to embrace new technologies to cope with the growing demand on resources.

"I acknowledge that in recent years we have done a fair job in employing methods to conserve our natural resources, but I believe we can do more - must do more. We are looking hard at more efficient irrigation methods and better ways to minimize water loss through evaporation. Technology and better planning will lead the way for better water efficiency in the years ahead. But we need to start now because the clock is running out," he said.

Mace says a promising conservation technique currently underway involves rainwater harvesting. He says collecting rainwater for household use is nothing new, but largely overlooked in modern times. And while rainwater collection is best suited for household use or on the lawn and in the garden, there are also applications for the farm, including water for livestock use.

"Some people say it is goofy to talk about rainwater harvesting during a time of drought, but I disagree. Every ounce of water we save is an ounce of water we can still use, and flushing toilets and watering the lawn can use a great deal more water than we realize. Efficiency in our water use is a key component to preserving our water resources," Mace added.

He says the Hill Country of Central Texas is leading the way nationally in demonstrating the effectiveness of rainwater harvesting. Many rural homes and barns still have old cistern tanks and collection systems in place as they were widely used across the region over the last 200 years, and many new homes are incorporating collection systems.

"With a little work, these systems are being put back into use and the amount of groundwater saved as a result can be very surprising," Mace said.

He illustrated the savings by noting a suburban homeowner near Boerne, Texas, who installed a large cistern system at his new home and collected nearly 50,000 gallons of water in recent years, and still has 25,000 gallons in the tank.

On Saturday, Dec. 10, the Expo program includes a presentation from Texas AgriLife Extension Program Specialist Brent Clayton, who will be highlighting rainwater harvesting efforts in Texas.

In addition to applications for agriculture, the Expo is open to homeowners and garden enthusiasts and the general public. Special programs for students and special interest groups are also scheduled.

For producers, five Texas Department of Agriculture continuing education units will be available in pesticide record keeping, pesticide laws and regulations, crop insect management, herbicide brush control, and general brush and weed control.

The Texas Irrigation Expo is the cooperative effort of the Texas Water Development Board, the Harlingen Irrigation District and the Texas AgriLife Research and Extension Center at Weslaco.

ROD SANTA ANA: South Texas soil testing campaign to run through February

Story | Comments | Image (2) | Print | Font Size:

Recommend 0 | Tweet | +1 0 | Pin it 0 | Share

Previous | Next

Rod Santa Ana

Ashley Gregor, an AgriLife Extension water program assistant in Weslaco, displays the tools needed to submit samples for a free soil testing campaign. (AgriLife Communications photo by Rod Santa Ana)


Buy this photo

Posted: Thursday, October 10, 2013 5:55 pm

Rod Santa Ana III | r-santaana@tamu.edu

WESLACO – Growers in the Lower Rio Grande Valley can save money while helping the environment by taking advantage of a free soil testing campaign, according to Ashley Gregory, a Texas A&M AgriLife Extension Service assistant for water programs in Weslaco.

"Agricultural producers from Hidalgo, Cameron and Willacy counties are encouraged to submit soil samples for a free analysis to help them determine the amount of nutrients in their soils," Gregory said.

Proper nutrient amounts and placement help in the reduction of nonpoint source pollution into the Arroyo Colorado and the Lower Laguna Madre, both important waterways in the Lower Rio Grande Valley, she said.

"By knowing how much fertilizer is already in the soil, many growers have been able to cut down on the fertilizer they apply. That can amount to a huge cost savings, especially with rising fertilizer prices," she said.

The soil testing campaign began Oct. 1 and will continue through Feb. 28. It is made possible by funding from a Clean Water Act grant provided the Texas State Soil and Water Conservation Board and U.S. Environmental Protection Agency. It is administered through the Texas Water Resources Institute and the Arroyo Colorado Watershed Partnership.

The partnership consists of 700 people, representing federal, state and private organizations working to improve watershed health, integrate management and seek out watershed project funding.

Soil sample forms and sample bags can be picked up at AgriLife Extension offices in Hidalgo, Cameron and Willacy counties, or at the Texas A&M AgriLife Research and Extension Center, 2401 E. Business 83 in Weslaco.

Conducted every year since 2001, the soil testing program has been very successful in helping growers know exactly how much residual fertilizer is already in the ground, Gregory said. More than 5,000 soil samples have been collected since the program started.

"Growers can return their soil samples to any of our offices for shipping to the Texas A&M Soil Testing Laboratory in College Station. The analysis is free and results are mailed directly to the grower," she said.

Rod Santa Ana III is a Texas A&M AgriLife communications specialist.

Conservation farming meeting set April 29 in Weslaco

April 15, 2014

Writer: Rod Santa Ana, 956-878-8317, r-santaana@tamu.edu
Contact: Ashley Gregory, 956-968-5581, ahgregory@ag.tamu.edu

WESLACO – Growers interested in best management practices that can help improve the soil health of their fields are encouraged to attend "Conservation Farming: Financial and Technical Assistance," to be held from 9 a.m. to 2 p.m. April 29 at the Texas A&M AgriLife Research and Extension Center at Weslaco.

Rene Ortega, farm equipment operator at the Texas A&M AgriLife Research and Extension Center at Weslaco, explains the mechanics of a laser land leveler to Ashley Gregory, an AgriLife Extension assistant for water programs. (AgriLife Communications photo by Rod Santa Ana)

The center is located at 2415 East U.S. Highway 83. The program is free and includes lunch.

"Growers are invited to come and learn about the conservation practices and programs that offer support for their field operations," said Ashley Gregory, Texas A&M AgriLife Extension Service assistant for the Texas Water Resources Institute.

Various agencies offer financial and technical assistance to implement practices such as land levelling and pipeline installation, which help improve water-use efficiency and reduce nutrient losses from runoff, Gregory said.

"Such practices also help the environment," she said. "The Arroyo Colorado still has nutrient, sediment and bacteria impairments. Healthy soils play a key role in reducing those harmful inputs into the Arroyo Colorado."

Representatives of several state and federal agencies that offer financial and technical assistance with improving soils will be on hand to provide information, Gregory said.

"Such practices also help the environment," she said. "The Arroyo Colorado still has nutrient, sediment and bacteria impairments. Healthy soils play a key role in reducing those harmful inputs into the Arroyo Colorado."

Representatives of several state and federal agencies that offer financial and technical assistance with improving soils will be on hand to provide information, Gregory said.

Topics and their speakers include:

– "Overview of issues in the Arroyo Colorado watershed," Gregory with Ronnie Ramirez, conservation planner, Texas State Soil and Water Conservation Board, Harlingen.

– "Managing the Rio Grande waters," Erasmo Yarrito Jr., Rio Grande watermaster, Texas Commission on Environmental Quality, Harlingen.

– "El Nino or 'La Nada': Will drought return this year?" Weather forecast for the upcoming season," Barry Goldsmith, warning coordination meteorologist, National Weather Service, Brownsville.

– "Surge valve cooperative and narrow border irrigation," Tom McLemore, project manager, Texas Project for Ag Water Efficiency, Harlingen.

– "Financial and technical assistance programs," Raul Hinojosa, district conservationist, U.S. Department of Agriculture-Natural Resources Conservation Service, Edinburg.

– "Marketing and finance programs," Nelda Garza, field representative, Texas Department of Agriculture, San Juan.

– "Microloan and operating loan programs," Arnulfo Lerma and Cristobal Perez, farm loan manager and county executive director, respectively, USDA-Farm Service Agency, Edinburg.

The program concludes with a question and answer session.

For more information, contact Gregory at 956-968-5581.

South Texas growers, experts to discuss water conservation incentives

August 8, 2014

Writer: Rod Santa Ana, 956-878-8317, r-santaana@tamu.edu Contact: Dr. Juan Enciso, 956-968-5585, j-enciso@tamu.edu Dr. Juan Anciso, 956-968-5581, janciso@ag.tamu.edu

WESLACO – South Texas farmers, crop consultants, technicians and anybody involved in crop irrigation are invited to a workshop to help brainstorm ideas on how to generate incentives for water conservation, according to experts at the Texas A&M AgriLife Research and Extension Center at Weslaco.

Dr. Juan Enciso, a Texas A&M AgriLife Research irrigation engineer, is an organizer of the upcoming Rio Grande Valley Agricultural Water Conservation Workshop, to be held Aug. 20 in Weslaco. (AgriLife Extension photo by Rod Santa Ana)

The free program, Rio Grande Valley Agricultural Conservation Workshop, will be held from 8 a.m.-3 p.m. Aug. 20 at the center, located at 2415 E. U.S. Highway 83 in Weslaco.

"Our water reservoirs have not been at full capacity since January 2011," said Dr. Juan Enciso, a Texas A&M AgriLife Research irrigation engineer at Weslaco and a program organizer.

"As of Aug. 4, Amistad Lake was at 39 percent of U.S. capacity and Falcon was at only 30 percent," he said. "So it's important to not only continue conserving as much water as possible, but to come up with ideas on how to encourage further savings."

An example of one such incentive, Enciso said, could be to reward growers who use more efficient irrigation systems with larger water allocations the following season.

"There are all kinds of scenarios like that that could help us all conserve, but we need to hear from growers and other experts and exchange ideas on incentives and how to make them viable," Enciso said.

Other topics to be discussed include new water conservation strategies, the weather forecast for the upcoming growing season and a panel discussion by irrigation district managers and growers on possible incentives.

Dr. Juan Anciso, a Texas A&M AgriLife Extension Service fruit and vegetable specialist at the Weslaco center, said July rains have helped, but the agricultural industry is still in crisis.

"We're not out of the woods yet," he said. "Water problems just won't go away, so we need to keep looking at cost-effective methods of water conservation."

One, he said, could be drip irrigation.

"Drip irrigation is nothing new," Anciso said. "But we're starting to see that more vegetable crops can benefit from such as system."

Anciso said that in a test plot of drip irrigation on onions and watermelons, water use was decreased while yields increased.

"This won't be the rule, but in our test we used half the amount of water on onions, and yields were twice what they normally are. We also saw yield increases in a watermelon test plot that had water savings of at least half. This is one way that using such as system can pay off for growers."

Both Enciso and Anciso said the onion and watermelon demonstration plots would be discussed at the Aug. 20 workshop.

Other speakers and topics include:

– Erasmo Yarrito Jr., Texas Commission on Environmental Quality, Harlingen, The current water situation in the Rio Grande.

– Barry Goldsmith, National Oceanic and Atmospheric Administration, Brownsville, Weather update and prediction for the coming season.

– Joe Barrera, Rio Grande Regional Water Authority, Harlingen, The Rio Grande Authority and emerging funding issues.

– Enciso, Irrigation water conservation, tools for irrigation management and watermelon experiment results

– Dr. Mir Seyedbagheri, University of Idaho Extension, Elmore County, Humic acids: Their role in moisture management.

– Panel discussion on irrigation districts and on-farm water conservation: Incentives for water conservation, and irrigation districts' ideas for water conservation. Panelists will include Wayne Halbert, Harlingen Irrigation District; Troy Allen, Delta Lake Irrigation District, Monte Alto; Joe Hinojosa, Santa Cruz Irrigation District; Dale Murden, Rio Farms, Inc., Monte Alto; and area growers.

– Dr. Luis Ribera, AgriLife Extension agricultural economist, Weslaco, Water economics.

The workshop will conclude with irrigation water demonstrations.

Article by Rod Santa Ana
956-878-8317
r-santaana@tamu.edu

View all articles by Rod Santa Ana →

Appendix E – Assessment of Educational Needs and Barriers to Adoption

An Evaluation of Educational Needs and Barriers to Practice Adoption for Agricultural Producers in the Arroyo Colorado Watershed

September 2014

ACRONYMS

BOD – Biochemical Oxygen Demand

BMP – Best Management Practice

EQIP – Environmental Quality Incentives Program

GLO – Texas General Land Office

SPSS – Statistical Package for Social Sciences

SWCD – Soil and Water Conservation District

TCEQ – Texas Commission on Environmental Quality

TMDL – Total Maximum Daily Load

TSSWCB – Texas State Soil and Water Conservation Board

USDA-NRCS – United States Department of Agriculture – Natural Resources Conservation Service

USEPA – United States Environmental Protection Agency

WPP – Watershed Protection Plan

ABSTRACT

Delivering appropriate educational programs and mitigating barriers to adopting sustainable agricultural practices are two of the most important factors when implementing agricultural sections of watershed-based plan. In this project, TWRI identified the primary barriers to adopting sustainable agricultural practices of agricultural producers in the Lower Rio Grande Valley as well as identified key areas for education programs. Of the 1,137 evaluations that were deliverable, 160 individuals responded with their input. This report contains the overall results of the responses.

INTRODUCTION

The Federal Clean Water Act §303 (United States Environmental Protection Agency, 2012) requires that states identify how water bodies in the state are used and establish criteria, or standards, needed to sustain those uses. To determine which water bodies do not meet the standards, the state is required to monitor for various parameters and report the findings. If water bodies do not meet the set standards, they are placed on what is commonly referred to as the 303(d) List, named after §303(d) of the Clean Water Act. In Texas, this is known as the *Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)*. Houck (1999) describes that once water bodies have been added to the 303(d) List, §303(d) of the Clean Water Act requires states to:

1. Pinpoint water bodies that will still be polluted even after available technology has been applied.
2. Highlight the water bodies while taking into account the severity of their contamination; and
3. Develop “total maximum daily loads” that take into account seasonality, economic growth, and a margin of safety to determine the maximum amount of pollution that a water body can receive and still meet water quality standards.

Watershed based plans, whether they be a Watershed Protection Plan (WPP) or Total Maximum Daily Load (TMDL) and Implementation Plan, have been developed across Texas. Figure 1 provides an overview of Watershed Protection Plans and Total Maximum Daily Loads that have been adopted statewide.

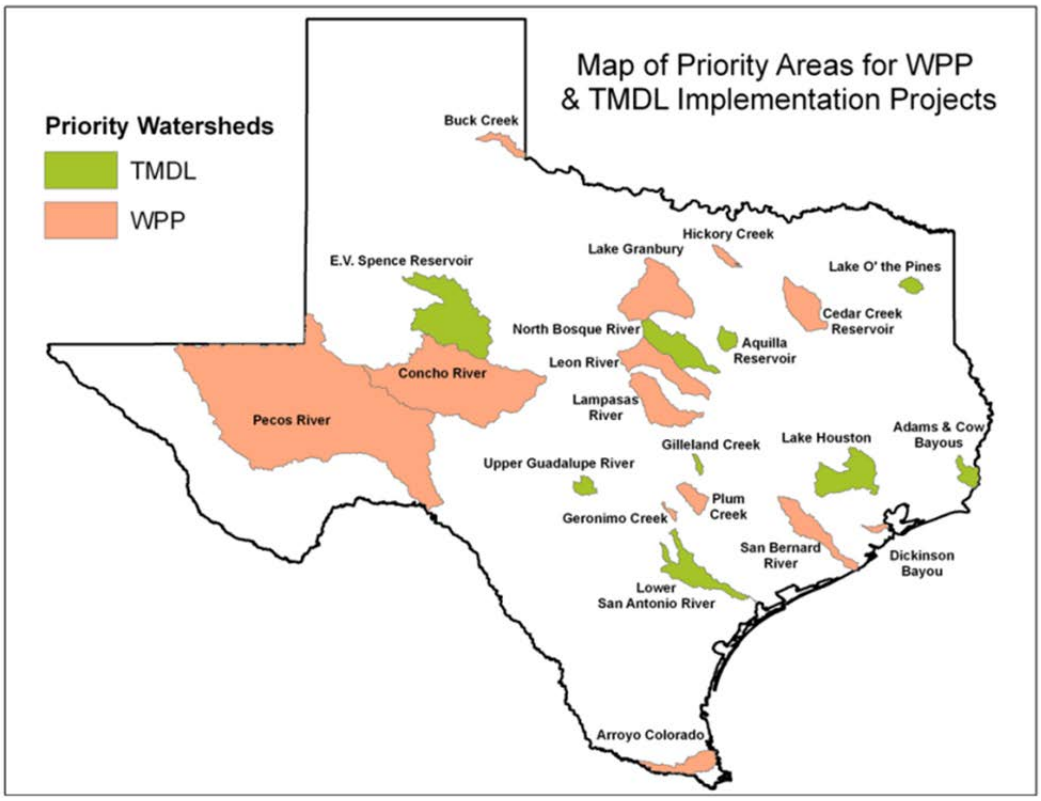


Figure 1. Map of WPPs and TMDLs in Texas

Agriculture has been identified as the primary contributor to nonpoint source pollution (United States Environmental Protection Agency, 2012) in the United States, and currently, there are no permitting methods or regulations for this source. The Texas Agricultural Code, §201.026, which contains information about nonpoint source pollution, charges the Texas State Soil and Water Conservation Board as the primary agency for activity relating to mitigation of agricultural and silvicultural (forestry) nonpoint source pollution. Specifically, this is done through voluntary efforts of planning, implementing, and managing programs and practices that reduce sources of pollution (FindLaw, 2013).This agency, along with other agencies in the state, take a watershed approach to prioritize efforts where nonpoint source pollution from agricultural and silvicultural activities have been identified as causing water quality impairments (Texas State Soil and Water Conservation Board, 2010). The TSSWCB's primary means for implementing agricultural management practices is through an incentive program called the Water Quality Management Plan Program, as directed by Texas Senate Bill 503 (Texas State Soil and Water Conservation Board, 2010). A Water Quality Management Plan is a plan developed by the landowner and the local Soil and Water Conservation District (SWCD) that, according to the TSSWCB (2010) Reference Guide, includes "appropriate land treatment practices, production practices, management measures, technologies or combinations thereof." The Water Quality Management Plan must be approved both at the local level and at the state level (Texas State Soil and Water Conservation Board, 2010). Further, other incentive programs, such as the United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) Environmental Quality Incentives Program (EQIP), are available to landowners to help pay for the adoption of sustainable agricultural practices. Challenges have become

apparent in some areas of the state due to the lack of participation in incentive programs and lack of adoption of sustainable agricultural practices. These challenges are partially related to economic, programmatic, information and awareness, and other social barriers. An assessment of educational needs and barriers to sustainable agricultural practice adoption is important to increase the effectiveness of the overall efforts. Additionally, an evaluation of the overall implementation effort is needed to determine what has been effective, what has been ineffective, and what areas of an implementation program need to be enhanced.

The Arroyo Colorado River is located in Cameron, Hidalgo, and Willacy counties in the Lower Rio Grande Valley of South Texas. The Arroyo Colorado flows for approximately 90 miles, beginning west of McAllen, transecting Hidalgo and Cameron counties and forming the boundary for Cameron and Willacy counties for the last 16 miles, until it reaches the Lower Laguna Madre. To the Lower Laguna Madre, the Arroyo Colorado is the primary source of fresh water and serves as a nursery for aquatic life (Arroyo Colorado Watershed Partnership, 2007). The land that drains into the Arroyo Colorado is known as the Arroyo Colorado Watershed. This watershed is approximately 706 square miles and provides various land uses. Those land uses have been classified by the Spatial Sciences Lab of Texas A&M University at College Station. Primary land uses include agriculture (54%), range (18.5%), urban (12%), water bodies (6%) and sugarcane (4%) (Kannan, 2012); however, vegetable and fruit crops are grown in portions of the watershed and other types of industry exist. Two of the primary users of water in the watershed are agriculture and municipalities, and flow in the Arroyo Colorado is primarily sustained by wastewater discharges and agricultural irrigation return flows; thus, the Arroyo Colorado serves as a conveyer of this water as it leaves the system. When wastewater discharges and agricultural return flows enter the Arroyo Colorado, they carry nutrients, sediment and bacteria, which pose a threat to the various users of the water.

The tidal segment of the Arroyo Colorado was first listed as having low levels of dissolved oxygen in 1996 and elevated levels of bacteria in 2006, while the above tidal segment was listed in 1996 for having elevated levels of bacteria (Texas Commission on Environmental Quality, 2013). As a result, an attempt to develop a total maximum daily load was initiated in 1998 to address the depressed dissolved oxygen impairment where results indicated that a near 90% reduction in pollutants would be needed (Arroyo Colorado Watershed Partnership, 2007). The Texas Commission on Environmental Quality (TCEQ) Commissioners determined that this was unattainable and the Watershed Protection Planning process began for the Arroyo Colorado watershed. The Arroyo Colorado Watershed Partnership was formed from two small groups that were developed during the Total Maximum Daily Load process of a Science and Technology Advisory Committee and Steering Committee to address the diverse contributors of pollution in the water body. The makeup of this partnership consisted of various key workgroups including 1) wastewater infrastructure, 2) agricultural issues, 3) habitat restoration, and 4) outreach and education (Arroyo Colorado Watershed Partnership, 2007). Some members of the workgroups, as well as a diverse group of other individuals, make up the Steering Committee, a group charged with making consensus decisions that represent all interests of the watershed.

Several workgroups developed recommendations in the form of technical documents, and portions of those were incorporated into the Arroyo Colorado Watershed Protection Plan (Phase I). The workgroup plans included the Arroyo Colorado Habitat Restoration Plan (2006), the Arroyo Colorado Watershed Partnership Education and Outreach Campaign (2006), and the Arroyo Colorado Watershed Protection

Plan: Components Addressing Agricultural Nonpoint Source Pollution (2007). Within the Agricultural Issues Workgroup recommendations, a goal was established to "encourage the voluntary adoption of best management practices (BMPs) to reduce suspended sediment levels resulting from cropland erosion, BOD (oxygen demanding organic material) from runoff crop residue, and nitrogen and phosphorus fertilizer runoff from irrigated croplands" (Agricultural Issues Work Group of the Arroyo Colorado Watershed Partnership, 2006). In an effort to achieve the goal, it was estimated that the voluntary adoption of BMPs on irrigated lands would be needed on approximately 150,000 acres, or 50% of total irrigated acreage in the watershed. As of 2007, voluntary BMPs had already been implemented on approximately 50,000 acres through the TSSWCB's Water Quality Management Plan Program and the USDA –NRCS EQIP; thus one-third of the goal had already been achieved (Agricultural Issues Work Group of the Arroyo Colorado Watershed Partnership, 2006). To accomplish the remaining two-thirds, the Agricultural Issues Workgroup (2006) proposed four types of additional assistance that would help reach the remaining acreage needed. Those types of assistance were:

- Technical Assistance – assistance in developing farm plans for individual landowners
- Cost-Share Assistance – payments to the producer to help implement sustainable agricultural practices
- Educational Programs – informative programs that would help producers become familiar with incentive programs, management practices, and other production methods; and
- Monitoring and Assessment – determining the contribution resulting from agricultural practices and demonstrate best management practices and their benefit.

The Agricultural Issues Workgroup (2006) developed a timeline of 10,000 acres annually that owners and managers would need to implement management practices on to reach the goal. The workgroup also recommended specific practices that would need to be adopted to reach the targeted load reductions. Finally, the workgroup determined cost estimates (Table 1) for the four types of assistance for the short term and long term that would be needed to reach the goals.

Table 1. 2007 Cost Estimates of the Agricultural Issues Workgroup (2006)

Type of Assistance	Short-Term Estimate (2005 - 2010)	Long-Term Estimate (2010 - 2015)
Technical Assistance	$475,000	$500,000
Cost-Share Assistance	$2.7 Million	$3 Million
Information/Education	$275,000	$300,000
Monitoring and Assessment	$750,000	$800,000
Total	$4.2 Million	$4.6 Million

As a result of the Arroyo Colorado Watershed Protection Plan, several projects have been developed for implementation and funded by various agencies, including, but not limited to, the Texas General Land Office (GLO), TCEQ, the TSSWCB, and the United States Environmental Protection Agency (US-EPA). These projects have had a wide array of focuses such as cost-share education for agricultural producers, public service announcements promoting a soil testing campaign, pesticide education, cost-share assistance, technical assistance, monitoring of irrigation BMPs, and computer modeling that simulates the effectiveness of sustainable agricultural practices.

As the US-EPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (2008) mentions, you can have a great plan; however, you need to implement that plan. Deciding how to implement your plan can be a difficult task. The last chapter of the handbook discusses what to do with a completed watershed plan. It discusses that you should begin with developing an organizational structure that will implement the watershed plan by using the skills that stakeholders have and identifying gaps that may exist and filling those gaps. To implement specific activities, the handbook recommends that technical assistance be available for all management measures and that training and follow up be provided. Financial mechanisms, progress tracking, and communicating results are also considered important components to implementing watershed-based plans. Finally, the handbook recommends that managers evaluate the program. Most literature focuses on developing organizational structure through collaborative watershed management, which was conducted in the Arroyo Colorado through development of the Partnership; however, the purpose of this paper is to present a way to prioritize implementation activities through identifying priority educational needs and barriers to adopting sustainable agricultural practices.

METHODS

To collect data, Dillman's (2000) Tailored Design Method was used where individuals were notified of their participation via postcard. This postcard contained a web link to the instrument, and potential participants were allowed one week to complete the evaluation online. After a week, a hard copy of the instrument, along with a cover letter containing an electronic link, were sent to participants. Two weeks after the hard copy evaluation was mailed, a reminder postcard was sent that also contained the web link. A final hard copy evaluation was mailed to participants two weeks after the reminder postcard that contained the web link as well. Individuals who returned the evaluation or indicated that they did not want to participate in the study were removed from the mailing list so that they were not mailed the evaluation more than once.

The response rate achieved in this evaluation was 24.1% (274 returned evaluations of the 1,137 that were deliverable) where 11 respondents completed the evaluation online, 91 from the first mailing, and 58 from the second. 114 individuals returned the evaluation opting not to complete it leaving researchers with 160 total usable responses. Results of this evaluation are not representative of the population as a whole but just those that responded during this evaluation. Table 2 contains demographic characteristics for those who returned the evaluation.

Statistical Package for Social Sciences (SPSS) Version 22 was used to conduct data analysis. Descriptive statistics were run for demographic, manifest (measurable), and latent (construct) variables. In addition, Cronbach's alpha was calculated for all manifest variables and each group of manifest variables that made up the latent variables. Finally, to determine if any differences may exist between those that responded and those that did not respond, responses to the first evaluation were being compared to responses of the second evaluation (Lindner, Murphy, & Briers, 2001).

Table 2. Demographic Characteristics of Participants

Characteristic	n	%
Age at time of evaluation (years)		
18 - 30	2	1.3
31 - 50	20	12.5
51 - 70	83	51.9
71 and over	47	29.4
Gender		
Male	128	80.0
Female	25	15.6
Ethnicity		
American Indian or Alaska Native	1	.6
Spanish, Hispanic, Latino	58	36.3
White	91	56.9
Education level		
Less than High School	9	5.6
High School Diploma	25	15.6
Some College	41	25.6
Bachelor's Degree	53	33.1
Post-Graduate Degree	25	15.6

Note. N=160

RESULTS

Educational Needs

To determine educational needs, TWRI developed an evaluation instrument that was used in an electronic and hard copy format. Sixteen questions requesting information about the perceived educational needs for agricultural producers were presented in a Likert Scale with six response options of Strongly Agree (1), Agree (2), Somewhat Agree (3), Somewhat Disagree (4), Disagree (5), and Strongly Disagree (6). These questions were arranged so that the first four questions related to water quality, questions five through eight were related to conservation practices, questions nine through twelve were related to financial incentives, and questions thirteen through sixteen were related to water quantity. An optional text response was included for participants to include any other educational needs that may not have included in the questions above. Finally, demographic information was asked of participants. This included educational level, gender, ethnicity, and age.

Sixteen variables were developed to assess the educational needs of agricultural producers. Table 3 contains the mean, standard deviation, and number of responses for the variables relating to the question "Please indicate your level of agreement regarding what you think are some educational needs for agricultural producers related to water." Combined, the variables resulted in a Cronbach's alpha of 0.96.

Table 3. Mean, Standard Deviation, and Number of Responses for Manifest Variables

Education Topic	M	SD	N
1. How water quality impacts your operation	1.77	.970	140
2. How agricultural production impacts water quality	1.88	.913	139
3. What current water quality levels are (eg. nutrients, salinity, etc.)	1.82	.859	137
4. Specific conservation practices that improve water quality	1.90	.911	139
5. How I can improve my operation by adopting conservation practices	1.94	.907	139
6. Updates on conservation practice effectiveness	1.95	.854	139
7. How to install/maintain conservation practices	1.96	.928	139
8. Fertility application methods (eg. nutrient management)	1.96	.924	139

9. Sources of financial incentives available to help pay for conservation practices	1.84	1.036	140
10. Requirements of financial incentive programs	1.99	1.007	139
11. How to apply for financial incentives	1.82	.921	136
12. Information about upcoming incentive programs	1.91	1.050	138
13. Specific conservation practices that reduce the amount of irrigation water used	1.79	.928	139
14. How much water is needed to produce various crops	1.91	.916	138
15. Current and new irrigation technologies	1.83	.937	139
16. How much irrigation water is available for the upcoming year	1.64	.969	140

To better classify the responses, variables were combined into latent variables, where manifest variables one through four were related to the construct of water quality, five through eight to conservation practices, nine through twelve to financial incentives, and thirteen through sixteen to water quantity. This allowed the researcher to determine what the highest broad priority areas were and then narrow them by manifest variable. Descriptive statistics for latent variables are displayed in Table 4. For each of the latent variables, a Cronbach's alpha was calculated and resulted in water quality – 0.87, conservation practices – 0.93, financial incentives – 0.94, and water quantity – 0.86.

Table 4 Mean, Standard Deviation, and Number of Responses for Latent Variables

Name of Variable	M	SD	N
Water Quality	1.84	.78	140
Conservation Practices	1.95	.82	140
Financial Incentives	1.90	.95	140
Water Quantity	1.80	.82	140

Note. Scale: 1.00-1.49 = "strongly agree;" 1.50-2.49 = "agree;" 2.50-3.49 = "somewhat agree;" 3.50-4.49 = "somewhat disagree;" 4.50-5.49 = "disagree;" 5.50-6.49 = "strongly disagree."

Barriers to Adopting Management Practices

Questions for this section were developed by generally following those that Rodriguez et al. (2008) had outlined in their study but additionally, participants were asked whether they had adopted practices to their operation or not. Eighteen manifest variables were measured (table 5) in an attempt to identify the priority barriers to adopting sustainable agricultural practices by asking participants to "Please indicate your level of agreement regarding the reasons you HAVE NOT adopted conservation practices through incentive programs." Cronbach's alpha was calculated with all manifest variables, called barriers to adoption, and resulted in an alpha of 0.91. Table 5 contains descriptive statistics (mean, standard deviation, and number of responses) for each manifest variable and participants' response to whether they had adopted or not. As seen, the initial cost of installing (M=2.05) as the barrier was agreed with the most, followed by incentive (cost-share) levels being too low (M=2.17) and the lack of available cost-share funds. (M=2.20). The first two barriers indicate that installing costs are an expense that producers are less willing to incur, but low cost-share levels also act as a barrier to adopting practices. A common message from producers in the area was that cost-share funds were unavailable, and a high agreement to the lack of cost-share funds supports this. Fourth, maintenance costs (M=2.22) act as a barrier to adopting practices. Cost-share programs assist in paying for the initial cost of installing; however, the maintenance cost is something that producers are sometimes not willing to incur. Next, both the eligibility of the incentive program (M=2.28) and lack of information about conservation practices effectiveness (M=2.28) act as barriers because some incentive programs provide one time only funds, and the lack of information about whether the conservation practice actually works can reduce the likelihood of adoption, respectively. Finally, the variable that respondents agreed with seventh most was that producers were uncertain if practices would increase or decrease profit (M=2.29). With the inclusion of the last variable, all of the economic barriers had been agreed with amongst the top half of all the variables. This indicates that economics, overall, may be the largest barrier to adopting sustainable agricultural practices. Objective two contains the results of that analysis and differences in means between respondents who have adopted practices and those that have not.

It should be mentioned that within the manifest variables, some statistically significant differences could be found between those that have and those that have not adopted practices and their response to manifest variables. Specifically, a difference could be found within the variable "4. Uncertain if practices will increase or decrease profit" [$F(1, 108) = 4.05$, $p = .05$] ($\eta_p^2 = 0.04$, $1- \beta = 0.51$) where respondents that have adopted practices (M=2.42, SD=1.15) agreed less that the variable was a barrier than those that have not adopted practices (M=2.02, SD=.93). Similarly, those that have adopted practices (M=2.88, SD=1.22) significantly differed [$F(1,106) = 5.791$, $p=.02$] ($\eta_p^2 = 0.05$, $1- \beta = 0.66$) from those that have not adopted practices (M=2.37, SD=.95) in their response to "7. Land does not meet the requirements of the program." Thirdly, responses to the variable "14. Lack of labor to implement conservation practices" differed significantly [$F(1,108) = 4.734$, $p=.03$] ($\eta_p^2 = 0.04$, $1- \beta = 0.58$) where those that have adopted practices (M=2.68, SD=1.22) agreed less about the variable being a barrier than those that have not adopted practices (M=2.20, SD=2.08). Finally, those that have adopted practices (M=3.13, SD=1.39) agree less than those that have not adopted practices (M=2.31, SD=1.13) to the variable of "15. Conservation practices are outside of my methods of operating" [$F(1,108) = 11.15$, $p = .001$] ($\eta_p^2 = 0.095$, $1- \beta = 0.91$) being a barrier.

Table 5. Descriptive Statistics for Manifest Barriers to Adoption by Adoption Category

Variable	Adopted Y/N	M	SD	N
1. Initial cost of installing	Yes	2.04	1.19	57
	No	2.00	1.14	53
	Total	2.02	1.17	110
2. Maintenance costs	Yes	2.38	1.27	58
	No	2.02	1.06	52
	Total	2.21	1.18	110
3. Incentive (cost-share) levels are too low	Yes	2.22	1.24	58
	No	2.00	0.97	52
	Total	2.12	1.12	110
4. Uncertain if practices will increase or decrease profit	Yes	2.42	1.15	57
	No	2.02	0.93	53
	Total	2.23	1.06	110
5. Eligibility of a program	Yes	2.32	1.18	56
	No	2.13	0.99	52
	Total	2.23	1.09	108
6. Lack of available cost-share funds	Yes	2.09	1.08	58
	No	2.22	0.97	51
	Total	2.15	1.03	109
7. Land does not meet the requirements of the program	Yes	2.88	1.22	56
	No	2.37	0.95	52
	Total	2.63	1.12	108
8. Terms of the contract	Yes	2.71	1.29	56
	No	2.44	1.07	52
	Total	2.58	1.19	108
9. Did not know about incentive programs	Yes	2.36	1.33	61
	No	2.35	1.20	52
	Total	2.35	1.27	113
10. Lack of information about conservation practice effectiveness	Yes	2.36	1.21	56
	No	2.15	1.04	52

	Total	2.26	1.13	108
11. Lack of opportunities to see practices at demonstrations	Yes	2.40	1.20	55
	No	2.15	1.00	52
	Total	2.28	1.11	107
12. Lack of educational opportunities about conservation practices	Yes	2.39	1.23	54
	No	2.22	0.99	51
	Total	2.30	1.12	105
13. Lack of time to implement/maintain conservation practices	Yes	2.71	1.25	56
	No	2.37	1.20	51
	Total	2.55	1.23	107
14. Lack of labor to implement conservation practices	Yes	2.68	1.22	59
	No	2.20	1.08	51
	Total	2.45	1.18	110
15. Conservation practices are outside of my methods of operating	Yes	3.13	1.39	56
	No	2.31	1.13	52
	Total	2.73	1.33	108
16. Belief that adopting practices would really make a difference in water quantity and/or water quality	Yes	2.72	1.49	57
	No	2.43	1.20	51
	Total	2.58	1.36	108
17. Operation size is too large to implement practices	Yes	3.95	1.41	56
	No	3.71	1.35	51
	Total	3.83	1.38	107
18. Do not want to be tied to a government program	Yes	2.95	1.62	61
	No	2.79	1.50	53
	Total	2.88	1.56	114

Note. Scale: 1.00-1.49 = “strongly agree;” 1.50-2.49 = “agree;” 2.50-3.49 = “somewhat agree;” 3.50-4.49 = “somewhat disagree;” 4.50-5.49 = “disagree;” 5.50-6.49 = “strongly disagree.”

Manifest variables were combined into latent variables to identify broad barriers to adopting sustainable agricultural practices. Cronbach's alpha for latent variables resulted in a 0.83 for economics, 0.79 for programmatic, 0.87 for information/ awareness, and 0.81 for producer/operation manifest variables. Table 6 below contains descriptive statistics for latent variables where economic barriers (M=2.16) were agreed with the most, followed by information/awareness barriers (M=2.33), programmatic barriers (M=2.45), and producer/operation barriers (M=2.72).

Statistically significant differences between several latent variables could be identified, beginning with a difference between Economic and Programmatic variables [$F(1,114) = 18.20$, $p = .001$] ($\eta_p^2 = 0.14$, $1- \beta = 0.99$) where respondents agreed more with Economic barriers than Programmatic barriers. Next, participants were significantly more likely to respond to Economic barriers than Information/Awareness barriers [$F(1, 113) = 3.90$, $p = .05$] (η_p^2 .03, $1- \beta$ .50) or Producer/Operation barriers [$F(1,113) = 38.34$, $p = .001$] ($\eta_p^2 = .25$, $1- \beta = 1.00$). A statistically significant difference was also identified between the Programmatic and Producer/Operation barriers [$F(1,111) = 13.40$, $p = .001$] ($\eta_p^2 = .11$, $1- \beta = .95$) and between Information/Awareness and Producer/Operation barriers [$F(1,116) = 26.99$, $p = .001$] ($\eta_p^2 = .19$, $1-\beta = .99$).

Table 6. Latent Barriers to Adoption Descriptive Statistics

	M	SD	N
Economic	2.16	0.95	118
Programmatic	2.45	0.95	116
Information/Awareness	2.33	1.07	121
Producer/Operation	2.72	1.01	122

Note. Scale: 1.00-1.49 = "strongly agree;" 1.50-2.49 = "agree;" 2.50-3.49 = "somewhat agree;" 3.50-4.49 = "somewhat disagree;" 4.50-5.49 = "disagree;" 5.50-6.49 = "strongly disagree."

Of the respondents, 71 (56.8%) indicated that they had adopted sustainable agricultural practices to their operation and 54 (43.2%) indicated that they had not. Further, there were no statistically significant differences between any latent or manifest barrier variables based on whether respondents had adopted or not.

SUMMARY AND CONCLUSIONS

Water quality can be difficult to manage for a watershed in its entirety, especially when there is a large population in the watershed. In the case of the Arroyo Colorado watershed, one of those populations consists of agricultural producers. As discussed in the previous chapters, there is a need to prioritize the approach taken when implementing agricultural components of watershed based plans. This study aimed to answer the following questions:

1. What are the primary educational needs for agricultural producers in Cameron, Hidalgo, and Willacy counties related to water?
2. What are the primary barriers to management practice adoption through incentive programs?

The first research question of the study, what are the primary educational needs for agricultural producers in Cameron, Hidalgo, and Willacy counties related to water, was answered by calculating means for each of the manifest (measurable) variables and by combining manifest variables into latent (construct) variables to provide overall priority areas. Bridges (2008) had mentioned the necessity of identifying local needs and Feather and Amacher (1994) discussed the lack of information available to help producers make decisions, both contributing to the lack of adoption. Within the study, it was determined that of the latent variables, water quantity was the highest educational need, followed by water quality, financial incentives, and conservation practices. Manifest variables that made up latent variables and were agreed with the most were how much irrigation water is available for the upcoming year, how water quality impacts your operation, specific conservation practices that reduce the amount of irrigation water used, what current water quality levels are (e.g., nutrients, salinity, etc.) and how to apply for financial incentives. Ribaudo and Horan (1999) mentioned that education is a common component of nonpoint source programs and also mentions that it is less expensive to deliver than cost-share programs. By delivering intensive educational programs, we could possibly help producers make the connection between different parameters and local water quality (Christenson & Norris, 1983).

There is a need to identify these barriers at the local level because of varying barriers across the state and the lack of commonality and some authors have even stated that “results are clearly inconclusive about what factors consistently determine BMP adoption” (Prokopy et al., (2008). The second research question of what are the primary barriers to management practice adoption through incentive programs.

First, means were calculated to identify which were the primary barriers to adopting sustainable agricultural practices. Also, manifest variables were combined into latent variables to identify the key areas that barriers fall into. Of the barriers, the initial cost of installing was the barrier that agricultural producers agreed with the most. The barrier agreed with the second most was that cost-share levels were too low, followed by the lack of cost-share funds available. Finally, the fourth highest barrier was related to maintenance costs of the practices. All of these barriers were related to economics, which was the area relating to the largest barrier, or latent variable, supporting Rodriguez et al (2008), and Drost et al (1996); however, for the purposes of this study, the lack of cost-share funds and cost-share levels being too low were part of the programmatic barrier. Of the remaining latent barriers, information/awareness ranked second (supporting Gillespie et al. (2007), Baumgart-Getz et al. (2012), Greiner et al. (2009), and Ryan et al (2003)), programmatic third, and producer/operation fourth (supporting Lamba et al. (2008)).

Of these manifest variables, significant differences could be identified between those that have adopted practices (agreeing less) and those that have not adopted (agreeing more) in their response to four manifest variables, meaning that those that have not adopted practices were more likely to agree less. Those manifest variables were “4. Uncertain if practices will increase or decrease profit,” “7. Land does not meet the requirements of the program,” “14. Lack of labor to implement conservation practices,” and “15. Conservation practices are outside of my methods of operating.”

REFERENCES

Arroyo Colorado Watershed Partnership. (2007). *A watershed protection plan for the Arroyo Colorado phase I*. Retrieved from: http://arroyocolorado.org/media/2639/watershedprotectionplan.pdf

Agricultural Issues Work Group of the Arroyo Colorado Watershed Partnership. (2006). *Arroyo Colorado watershed protection plan: Components addressing agricultural nonpoint source pollution*. Retrieved from: http://arroyocolorado.org/media/2632/componentsaddressingagnsp.pdf

Baumgart-Getz, A., Prokopy, L. S., & Floress, K. (2012). Why farmers adopt best management practice in the United States: A meta-analysis of the adoption literature. *Journal of Environmental Management*, *96*(1), 17-25. doi:10.1016/j.jenvman.2011.10.006

Bridges, C. A. (2008). Identifying agriculture and forestry educational needs using spatial analysis techniques. *Journal of Extension,[Online]*, *46*(3). Retrieved from http://www.joe.org/joe/2008june/tt6.php

Christensen, L. A., & Norris, P. E. (1983). Soil conservation and water quality improvement: What farmers think. *Journal of Soil and Water Conservation*, *38*(1), 15-20. Retrieved from http://www.jswconline.org/content/38/1/15.full.pdf+html

Dillman, D. (2000). *Mail and internet surveys: The tailored design method* (2nd ed.). New York, NY: John Wiley & Sons, Inc.

Drost, D., Long, W., Wilson, D., Miller, B., & Campbell, W. (1996). Barriers to adopting sustainable agricultural practices. *Journal of Extension*, *34*(6). Retrieved from http://www.joe.org/joe/1996december/a1.php

Feather, P. M., & Amacher, G. S. (1994). Role of information in the adoption of best management practices for water quality improvement. *Agricultural Economics, 11*(2), 159-170. Retrieved from http://www.sciencedirect.com/science/article/pii/0169515094000131

FindLaw. (2013). *Tex ag. code ann. section 201.026: Texas statutes-section 201.026.* Retrieved from website: http://codes.lp.findlaw.com/txstatutes/AG/7/201/B/201.026

Gillespie, J., Kim, S., & Paudel, K. (2007). Why don't producers adopt best management practices? An analysis of the beef cattle industry. *Agricultural Economics*, *36*(1), 89-102. doi:10.1111/j.1574-0862.2007.00179.x

Greiner, R., Patterson, L., & Miller, O. (2009). Motivations, risk perceptions and adoption of conservation practices by farmers. *Agricultural Systems*, *99*(2), 86-104. doi:10.1016/j.agsy.2008.10.003

Houck, O. A. (1999) *The Clean Water Act TMDL program: Law, policy, and implementation*. Washington, DC: Environmental Law Institute.

Kannan, N. (2012). *Swat modeling of the Arroyo Colorado watershed* (Texas Water Resources Institute, Technical Report 426). Retrieved from website: http://twri.tamu.edu/reports/2012/tr426.pdf

Lamba, P., Filson, G., & Adekunle, B. (2009). Factors affecting the adoption of best management practices in southern Ontario. *The Environmentalist*, *29*(1), 64-77. doi:10.1007/s10669-008-9183-3

Lindner, J. R., Murphy, T. H., & Briers, G. E. (2001). Handling nonresponse in social science research. *Journal of Agricultural Education*, *42*(4), 43-53.

Prokopy, L. S., Floress, K., Klotthor-Weinkauf, D., & Baumgart-Getz, A. (2008). Determinants of agricultural best management practice adoption: Evidence from the literature. *Journal of Soil and Water Conservation*, *63*(5), 300-311. Retrieved from http://www.jswconline.org/content/63/5/300.full.pdf+html

Ribaudo, M. O., & Horan, R. D. (1999). The role of education in nonpoint source pollution control policy. *Review of Agricultural Economics*, *21*(2), 331-343. doi:10.2307/1349883

Rodriguez, J. M., Molnar, J. J., Fazio, R. A., Sydnor, E., & Lowe, M. J. (2008). Barriers to adoption of sustainable agricultural practices: Change agent perspectives. *Renewable Agricultural Food Systems*, *24*(1), 60-71. doi:10.1017/S1742170508002421

Texas Commission on Environmental Quality. (2013, February 13). *Draft 2012 Texas integrated report - Texas 303(d) list (category 5)*. Retrieved from http://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/12twqi/2012_303d.pdf

Texas State Soil and Water Conservation Board. Texas State Soil and Water Conservation Board. (2010). *Reference guide for a water quality management program to address agricultural and silvicultural nonpoint source pollution*. Retrieved from: http://www.tsswcb.texas.gov/files/docs/nps-wqmp/SB503Manual_Revised_.pdf

United States Environmental Protection Agency. (March 2012). *Clean water act section 303*. Retrieved from http://water.epa.gov/lawsregs/guidance/303.cfm

United States Environmental Protection Agency. (September 11, 2013). *Handbook for developing watershed plans to restore and protect our waters.* Retrieved from http://water.epa.gov/polwaste/nps/handbook_index.cfm