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Water Quality Studies in Rural Watersheds

TAEX Efforts Assess Pollution Prevention in Key Agricultural Areas

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Currently, there are four water quality projects that are being conducted to assist agricultural producers so they can reduce or prevent non point source water pollution.

These programs are cooperative efforts of federal, state, and local agencies. Lead agencies in the joint venture include the Texas Agricultural Extension Service (TAEX), and the U.S. Department of Agriculture's Cooperative State Research, Education and Extension Service (USDA/ CSREES) Natural Resources Conservation Service (USDA/ NRCS) and Consolidated Farm Service Agency (USDA/ CFSA). The projects are carried out in conjunction with the Texas State Soil and Water Conservation Board and local soil and water conservation districts. TAEX and NRCS have project managers at each site to coordinate activities.

Other cooperating agencies include the U.S. Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), the Texas Natural Resource Conservation Commission (TNRCC), and the Texas Agricultural Experiment Station (TAES).

These agencies are working together with producers, commodity organizations, city and county officials, and the general public to improve water quality across the state.

The four projects include the Upper North Bosque River Hydrologic Unit Area (HUA) Project, which is in north central Texas; the Seco Creek Water Quality Demonstration Project, which is located over the Edwards Aquifer; the Lake Fork Creek HUA Project in northeast Texas; and the Seymour Aquifer HUA Project, which is located in north central Texas.

Each of these projects began in 1990 or 1991. They address various rural water quality problems in different parts of the state. All of the projects are working to demonstrate best management practices (BMPs). The goal is to reduce nonpoint source pollution by encouraging voluntary adoption of pollution prevention practices by producers. This is done through educational, technical, and financial assistance.

In the following sections, activities and results associated with each project are discussed.

Upper North Bosque River Project

The South Fork and North Fork of the North Bosque River flow in a south-southeasterly direction and come together to form the Upper North Bosque River above Stephenville in north-central Texas. This river flows through Erath, Hamilton, and Bosque counties into Lake Waco, which is used for municipal water supplies.

In 1990, the 290,040-acre project began with the goal of bringing about voluntary adoption of BMPs by the producers to improve water quality in the river. The Brazos River Authority, and the Texas Institute of Applied Environmental Research (TIAER) at Tarleton State University are working with other cooperating agencies in this project.

One of the main thrusts of the Upper North Bosque Project is to find ways to manage dairy wastes to lessen runoff pollution. In this photo, dairy manure is being scraped from a lot so it can later be applied to cropland.

Dairy farming is an important industry in the communities surrounding the project area, and Erath county is one of the largest milk producing counties in Texas with over 200 dairies. The Upper North Bosque River watershed includes 127 dairies with a combined herd of 38,556 cows. Other agricultural production in the area includes peanuts, hay, orchard crops, and beef cattle.

The primary objective of the project is to reduce fecal coliform and nutrient levels in the Upper North Bosque River. Demonstrations of efficient dairy waste management systems that help in achieving pollution control are important to the project and to the producers in their efforts to protect surface and ground water quality. Project personnel offer educational materials, technical assistance, and cost-share assistance to dairy producers to help them design and implement waste management systems.

Stream monitoring from 1991 through 1994 reveals that, on average, fecal coliform levels in the river were reduced by 75%, while nitrate concentrations were cut by 77%. These reductions have occurred in part because dairy operators have been encouraged to adopt waste management and water use methods that protect water quality, to apply proper

waste application rates, and to employ year-round forage systems. As a result, roughly 44,541 tons of dairy manure is applied to 2,531 acres of cropland each year.

Another advantage to producers adopting BMPs is cost savings. Since 1991, an estimated $445,410 has been saved through the use of dairy manure as a replacement for commercial nitrogen fertilizer. Another $222,705 has been saved collectively by producers through the use of dairy manure instead of commercial phosphorus application. Potassium inorganic fertilizer usage also is down because of dairy manure use, with a savings of $400,869 to the producers who are adopting the practice.

BMPs have been adopted by producers that lower water use in the project. Eleven dairies have adopted water conservation practices that reduced groundwater consumption by an average of two gallons per cow per day with a cumulative use reduction of 154 acre-feet of groundwater per year. Water conservation practices by these 11 dairies have reduced the amount of wastewater being produced each year by 4.5 million gallons. In addition, each dairy saves roughly $350 annual in lower electricity bills.

The agencies, producers, and the public in the region are interested in proven impacts, but these changes could not have occurred without educational programs and materials developed through the project. These educational events include field days, demonstration models, tours of dairies using BMPs, and training programs. Technical and financial assistance have been invaluable aids in helping producers adopt BMPs.

The Upper North Bosque River HUA project hosts the Southwest Dairy Field Day every other year. This event, which features tours and educational programs, is attended by over 700 producers and exhibitors. The 1995 field day featured outstanding programs and more than 750 people attended.

Educational programs also are carried into the classrooms in local school districts. Twice each year, project personnel talk to agricultural students in Stephenville about water quality and environmental issues. In addition, more than 20,000 people have received educational materials or attended programs sponsored by the project since 1990.

Continuing activities in the project area include an irrigation scheduling and soil moisture monitoring demonstration with three peanut producers; a vegetative filter-strip demonstration to minimize nutrient and sediment losses from agricultural fields; and an integrated pest management demonstration evaluating biological, chemical, and mechanical control of fly populations on dairy farms. In addition, this project includes the only wetland in Texas specifically maintained for dairy waste management.

Seco Creek Water Quality Demonstration Project

The Seco Creek Water Quality Demonstration Project is located in south Texas, where Seco Creek flows across the recharge zone of the Edwards Aquifer. Because the Edwards Aquifer is rapidly and directly recharged, and because more than 1.5 million people depend on the aquifer for drinking water, the quality of recharge water is a major concern.

Project personnel work to develop and demonstrate practices that reduce or prevent pollution and improve water quality. Water conservation and efforts to increase water yields are encouraged through the project's educational programs and demonstrations. The project area is comprised of 170,670 acres in portions of Bandera, Medina, Uvalde, and Frio Counties. Agricultural production includes corn, sorghum, cotton, vegetables, and beef cattle.

Personnel from the Texas Agricultural Extension Service, the Natural Resource Conservation Service, and other agencies examine this sinkhole near Seco Creek. Geologic features like this could provice pathways for contaminants to rapidly enter the Edwards Aquifer and are a major water quality concern.

The project is one of only 16 national USDA Water Quality Demonstration Projects. These projects are unique because they are designed to protect high quality waters from non-point sources of pollution. This is the only project in the nation focusing on rangeland BMPs.

A 1,500 cubic yard catchment and recharge structure has been constructed to hold an inch of runoff from a 40-acre rangeland watershed. This structure allows about 650,000 additional gallons of water to be recharged into the Edwards Aquifer each year.

Another source of increasing water availability has been investigated through studies conducted by Bill Dugas and colleagues with the Texas Agricultural Experiment Station Blackland Research Center in Temple. The study, which was conducted as part of the Seco Creek Project, evaluated the effects of removing ashe junipers on the soil-water balance on rangelands in the region. Two years of post-treatment data indicate that spring flows increased by 60,000 gallons per acre per year after all ashe juniper were removed from a 40-acre site.

Nutrient management programs have reduced applied nitrogen by 500,000 pounds since the beginning of the project. Edge-of-field losses decreased by 27% and leaching losses were cut by 40%. Atrazine use has been reduced by 13,500 pounds on 9,000 acres in the project area, and pesticide applications have been reduced by 45,000 pounds through the use of alternative practices.

Since 1990, sediment loading has been reduced by 250,000 tons through the implementation of cultural practices on cropland, improved grazing management, and brush and vegetation control strategies on rangeland. Infiltration rates were increased by 600% after grassy filter strips were established. At the same time, sediment losses dropped to an average of 130 pounds per acre. On nearby cropland where these practices were not used, sediment losses were roughly 6,500 pounds per acre.

The Seco Creek project received the Governor's Award for Environmental Excellence in Agriculture in 1994. This award is part of the TNRCC Clean Texas 2000 Program. Part of any good project involves developing quality educational materials and programs. Personnel with the Seco Creek Water Quality Demonstration Project have been working with landowners and producers in the area by providing 56 demonstration sites that include more than 400 examples of 60 different BMPs. Currently, conservation practices are being applied on about 75% of the acreage in the watershed as part of these programs. More than 37 long-term cost-sharing contracts have been developed with landowners to assist them in applying BMPs on 35% of the land in the project area.

Educational materials and programs have been developed for public school students. More than 2,000 students from the surrounding school districts have been exposed to the program. Project personnel also conducted 260 tours for more than 50,000 people from the U.S. and many foreign countries since the beginning of the project.

Lake Fork Creek HUA Project

The Lake Fork Creek HUA Project is located in northeast Texas in the Sabine River Basin. The 276,450-acre project includes parts of Hopkins, Rains, and Wood Counties and drains into Lake Fork Reservoir, which is a source of drinking water for Dallas and other cities in the region.

Lake Fork Creek project personnel work closely with the Sabine River Authority and the agencies listed in the beginning of this article.

This program began in 1991. The overall goal is to accomplish rapid, voluntary producer implementation of recommended practices and systems through extensive and focused educational, technical, and financial assistance programs.

Because many dairies are located in this region, an emphasis has been placed on helping dairy producers install animal waste management systems. Agricultural production in the project area includes sweet potatoes, watermelons, forages, and poultry. The project is

investigating such sources of nonpoint source water pollution as nutrients, pesticides, and rural wastewater treatment systems.

Participants in a field day at the Lake Fork Creek HUA Project observe how this solids separator operates. The separator improves water quality from dairy wastes and small municipal wastewater systems.

Some producers in the project area have reduced the amount of commercial nitrogen fertilizer used annually by 70 pounds per acre and commercial phosphorus fertilizer by 154 pounds per acre by properly applying animal wastes. Throughout the region, these practices reduced annual nitrogen use by 615 tons and annual phosphorus use by 300 tons. This saves agricultural producers more than $44 per acre each year.

Installing erosion control practices on 19,000 acres in the project has saved 70,420 tons of soil annually. In addition, 198 producers in the project have planted pastures and hay to control erosion and reduce sediment losses on 5,880 acres. Project personnel helped install 27 waste storage ponds, and 11 of those have water conveyance systems to apply lagoon effluent. Since the inception of the project, 82 waste storage/treatment facilities have been installed.

Lake Fork Creek HUA project personnel have created demonstrations, conducted tours, and developed educational materials. An annual field day is attended by an average of more than 400 producers and agribusiness exhibitors. Project personnel have hosted the Southwest Dairy Field Day. A monthly newsletter is distributed nationwide to dairy owners, researchers, agency personnel, and concerned individuals. A free soil testing program for analyzing fertilizer and animal waste applications has been successful and is still ongoing.

Project personnel are currently assisting with the design of an alternative animal waste management system computer software package. This system is based on information generated in part from project demonstrations. Other on-going studies in the project include comparisons of the use of commercial fertilizer and poultry litter on the growth of coastal Bermuda grass; an assessment of an alternative waste storage and wastewater treatment system; and forage consumption on planned grazing systems.

Seymour Aquifer HUA Project

The Seymour Aquifer HUA Project covers 274,500 acres in portions of Haskell and Knox Counties in northwest-central Texas, where many water wells exceed the federal safe drinking water standards for nitrate-nitrogen. With the predominance of sandy soils in the area and the shallow depth to groundwater, there is a significant risk that nitrate and other pollutants may contaminate the aquifer. Crops produced in the project area include cotton, peanuts, wheat, grain sorghum, and melons.

Irrigation scheduling, based on soil moisture monitoring, has increased by 458% since 1992, and 96 center pivot irrigation systems have been installed since 1991. These systems replaced less efficient sideroll and handmove systems. Information generated by a low energy precision application (LEPA) demonstration initiated at the inception of the project has resulted in the conversion of 15 center pivot systems, representing 1,955 acres in the project area. LEPA systems are substantially more efficient than conventional center pivots and cause much less leaching of nitrogen and other chemicals into the aquifer. In addition, implementation of irrigation water testing reduced nitrogen applications by two pounds per acre on 11,200 acres for a total reduction of 22,400 pounds since 1991.

Efforts in the Seymour Aquifer HUA Project include field testing of efficient irrigation systems. here, project personnel and agricultural producers examine wheat grown with a modified center pivot.

Because irrigation water quality testing has been implemented, nitrogen applications have been reduced by two pounds per acre on 11,200 acres. Total nitrogen loads in the region have been cut by 22,400 pounds since 1991.

Acreage dedicated to the Conservation Reserve Program (CRP) has reduced overall nitrogen fertilizer use in the project area by 30 pounds per acre on 29,650 acres, for an annual reduction of about 888,000 pounds. Because conservation cropping sequences and crop residue management practices have been adopted, nitrogen fertilizer use has been cut by 18 pounds per acre on 93,800 acres. This reduced annual nitrogen loads by nearly 1.7 million pounds of nitrogen. Nitrogen leaching potential has been reduced by 187,000 pounds. Encouraging the use of conservation practices and cover crops reduced phosphorus applications by 1.5 pounds per acre, for a total reduction of 22,400 pounds since 1991.

Cotton is one of the most extensively grown commodities in this area, so the project has implemented programs designed to address cotton production. A boll weevil and bollworm/budworm pesticide management program that includes a trapline was established in the project area. Pest numbers have been used by producers to schedule insecticide applications and eliminate unnecessary applications. In addition, approximately 52,500 acres of cotton are scouted for insect infestation levels. Scouting helps producers make more efficient pesticide applications and commonly eliminates at least one application per season.

Educational materials have been instrumental in making this project successful. More than 130 producers attend the Haskell County Agriculture Day, which provides training in pesticide management and water quality. Teacher education programs involving water quality have been conducted by project personnel, and 48 teachers in local school districts have received these materials. Students from a local school district participate in educational programs conducted by project staff, and students toured demonstration sites in the project area.

The project utilizes two weather stations in the area to provide data so producers in the region can make more informed management decisions. A study is on-going that uses a global positioning system to map weed infestations in the field. With this system, herbicides can be applied in variable rates where weed pressures are expected to be high, thus reducing overall herbicide use. This on-going study has been featured in the *Southwest Farm Press.*

Summary

These water quality projects are successful be cause of the combined efforts of agency personnel and the voluntary cooperation of agricultural producers. Results of these projects clearly show that agricultural producers are willing to implement needed practices to protect the environment. This is especially true when they are provided with the information, educational materials, and technical assistance to help them make needed changes.

For More Information

The Texas Agricultural Extension Service (TAEX) has produced many reports describing the water quality studies mentioned in this newsletter. The reports listed below are available from your county Extension agent or by calling the TAEX Soil and Crop Sciences Department at Texas A&M University at (409) 845-2425 or TAEX Publication Distribution at (409) 845-6571.

Overview of Management Program (L-5032), TAEX, Texas A&M University, College Station, TX.

Management Program Implementation (L-5033), TAEX, Texas A&M University, College Station, TX.

Fertilizer Management (L-5034), TAEX, Texas A&M University, College Station, TX.

Pesticide Management (L-5035), TAEX, Texas A&M University, College Station, TX.

Harvest-Aid Chemicals (L-5036), TAEX, Texas A&M University, College Station, TX.

Tillage and Cropping Systems (L-5037), TAEX, Texas A&M University, College Station, TX.

Silvicultural Practices (L-5038), TAEX, Texas A&M University, College Station, TX.

Irrigation Return Flows (L-5039), TAEX, Texas A&M University, College Station, TX.

Salinity Control (L-5040), TAEX, Texas A&M University, College Station, TX.

Grazing Management (L-5041), TAEX, Texas A&M University, College Station, TX.

Urban Runoff (L-5042), TAEX, Texas A&M University, College Station, TX.

Animal Waste Management (L-5043), TAEX, Texas A&M University, College Station, TX.

Animal Waste Application (L-5044), TAEX, Texas A&M University, College Station, TX.

Fertilization of Crops with Feedlot Wastes on the Texas High Plains (L-1220), TAEX, Texas A&M University, College Station, TX.

Protection of Groundwater from Fertilizers and Pesticides (B-1642), TAEX, Texas A&M University, College Station, TX.

New Publications from TWRI Examine Rio Grande Water Quality, Nitrogen Mineralization, Lake Property Values

Many new publications are available from the Texas Water Resources Institute (TWRI). New technical reports cover such topics as water quality in the Rio Grande, the value of water for recreation and aesthetic uses near Austin, and methods to measure mineralizable nitrogen in soils to assess groundwater pollution risks.

Flow, Salts and Trace Elements in the Rio Grande: A Review (TR-169) is a joint publication of TWRI and the Texas Agricultural Experiment Station (TAES). It was written by Seiichi Miyamoto and Lloyd Fenn of the TAES Agricultural Research and Extension Center at El Paso and Dariusz Swietlik of the Texas A&M University -- Kingsville Citrus Research Center. Sections of the report focus on flows of the Rio Grande, water use, how salts and trace elements affect water quality, how the water

quality in the Rio Grande compares to State and Federal standards, and implications for future research.

Two technical reports will be printed shortly.

Recreational and Aesthetic Value of Water in Lake Travis and Lake Austin (TR 170) was written by Notie Lansford and Lonnie Jones of the Texas A&M University Agricultural Economics Department. This report examines whether home buyers in the Austin area are willing to pay a premium for homes and lots that have access to and scenic views of lakes in the region.

Soil Nitrogen Mineralization Potential for Improved Nitrogen Fertilizer Recommendations and Decreased Nitrate Contamination of Groundwater (TR 171) was written by Frank Hons. This report describes research to evaluate different methods to measure nitrogen mineralization (the release of nitrate-nitrogen from soil organic matter). Research results suggest that measuring carbon dioxide emissions from soils that have been air dried and later rewetted may be a reliable, rapid way to measure nitrogen mineralization.

TWRI is still selling copies of the Proceedings of the 1995 *Water for Texas Conference: Research Leads the Way*. This 735-page book contains most of the papers that were presented at the Conference. Research involving many water issues is presented. The book costs $30.

TWRI Boosts Internet Efforts Through TWRI WaterNet, Computerized Mailing List, Public School Education

TWRI is involved in many efforts to increase the amount of water research information that is available over the Internet. The efforts are led by TWRI Information Specialist Ric Jensen and students Steve Fuller and Jonathan Jones.

Most of the efforts center around the TWRI WWW page, 'Texas WaterNet." This home page is available to computer users with Internet access. Information on the home page includes full text, photos and graphics from TWRI quarterly newsletters, abstracts of technical reports, information on TWRI staff, a searching tool that links users to all the information TWRI has put on the WWW site, a searchable database of university experts in Texas who are studying water issues, links to other sites, and summaries of TWRI research projects.

"We have been operating TWRI WaterNet since March and the response has been very positive," Jensen says. "TWRI WaterNet gives us the opportunity to provide greater access to TWRI publications to a large number of people. Because the WWW site is computer-based, it is incredibly easy for users to search for, download, and print the information they seek."

Recently, TWRI began operating a computerized mailing list called 'TWRI WaterTalk." This site will allow TWRI to send information such as requests for proposals and seminar announcements to a large number of researchers at once. A side benefit will be that users can post messages and respond to comments and questions that others have submitted.

"We envision that TWRI WaterTalk will eventually take on the form of an ongoing conference or discussion group that people can access from their offices," Jensen says. "If someone wanted information on the water quality needed to grow peaches in Central Texas, for example, they could send a message to TWRI WaterTalk. Others on the list could offer ideas and opinions about what the best solutions are."

Jensen is also leading efforts to introduce public school teachers to the TWRI WaterNet, in particular, and the WWW, in general. The project, which is being funded by the U.S. Environmental Protection Agency Environmental Education Program, will focus on adding new resources to TWRI WaterNet, such as QuickTime video segments and curriculum materials.

Jensen is working with Glenn Shinn of the Texas A&M University Agricultural Education Department to introduce as many as 100 agricultural and life science teachers to TWRI WaterNet at a January 1996 workshop that will be held at Texas A&M University. Those teachers are currently being surveyed about their ability to use the Internet and how effective they perceive it is. After the workshop, a follow-up survey will measure if their perceptions have changed.

TWRI is working with the U.S. Geological Survey (USGS) and State and Federal agencies to increase the distribution and communication about water issues over the Internet. An organizational meeting was held in Austin in July to introduce users to WWW sites with information on Texas water issues. Minutes from that meeting are now posted on TWRI WaterNet.