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**Program Code:** XJ

**Program Name:** Sustainable Agriculture Freshwater

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{NO DATA ENTERED}

**Departments**

{NO DATA ENTERED}

**Non-Technical Summary**

Utilizing the diverse expertise and skills of researchers from all the universities in the Texas State University System, the SAWC research project will focus on identifying and analyzing constraints to the sustainable use of this important transboundary water system, with the goal of developing real solutions that can be effectively implemented by land managers. All proposed activities are built upon the previous four years of systematic research. This project will expand our understanding of the Rio Grande and the factors affecting its sustainable use, as well as providing a means of formulating workable solutions to the identified problems that are acceptable to water stakeholders on both sides of the border. This FY2009 proposal includes 20 separate research projects. Sul Ross State University is the primary awardee and will manage the project. The project includes five subawards: Texas State University - San Marcos; Lamar University at Beaumont; Sam Houston State University (all Texas State University System schools); The University of Texas - Pan American; and, Rocky Mountain Bird Observatory. Four of the projects (Lamar in collaboration with Sul Ross State University; Texas State University - San Marcos in collaboration with University of Texas Pan American; Sul Ross State University in collaboration with Texas State University - San Marcos; and, Sul Ross State University in collaboration with Rocky Mountain Bird Observatory) include collaborative efforts between two institutions. The SAWC research project has recorded many achievements as a result of the four previous years of funding. Research projects are intended to reflect the Transboundary Diagnostic Analysis developed by Dr. Walter Rast for the Rio Grande bi-national watershed. Past research has focused on ground water; surface water; biological resource inventories; water treatment options; database development, management and the implementation of a data clearinghouse; and the establishment of the Rio Grande Research Center on the campus of Sul Ross State University in Alpine, Texas.

**Accomplishments**

**Major goals of the project**

Activities: creating a basin-wide perspective for the sustainable use of water resources; continued research includes the assessment of contaminants and pollutants in the Rio Grande Basin watershed, impact of global climate change on precipitation and acid deposition in the basin region, mapping and monitoring of native and exotic vegetation in Trans Pecos, Texas, grassland bird assessment, and relationships of river flow and nutrient loading to estuarine communities of the Lower Rio Grande; new studies include geo-referencing Rio Grande herbarium specimens, characterizing spatial variation in stream habitats and fish communities, multi-phase project using large-scale composting to manage invasive plant species along the river, conduct basin-wide surveys of biotic and abiotic conditions of stream segments and assess spatial patterns of aquatic biodiversity and causative disturbance gradients, investigate precipitation and land-use trends in the Rio Conchos watershed, compare efficacy of two tamarisk beetle species in tamarisk biocontrol, evaluate effects of tamarisk biocontrol on floral and wildlife diversity, effects of invasive species on the biogeochemistry of hyporheic water from sandbars through comparison of

restored and unrestored areas in Big Bend National Park, and investigate the impacts of changes in watershed management practices and the hydrology of the watershed. Events: review requests for proposals; annual report presentation for stakeholders and constituents; participate in local water and natural resource management meetings; demonstration of composting operation using Rio Grande River invasive plants; present watershed report tool to stakeholders; continue participation in Trans Pecos collaborative efforts. Services: GOES monitoring; Rio Grande environmental literacy and capacity building; provide hands-on education and public outreach among 4-H and other middle school students on arsenic analysis; implement focus groups and disseminate household surveys addressing water norms and conservation efforts in Hidalgo County, Texas; train stakeholders on the watershed report tool. Products: SAWC Operating Plan; Annual SAWC workshop; Rio Grande Research Center web site management; Rio Reach newsletter; extent of pesticide and pharmaceutical contamination and airborne pollution; determine impact of global climate change on the precipitation and acid deposition in the basin region; distribution maps of wetland taxa, trees and shrubs, and invasive species found on both side of the Rio Grande and Rio Bravo; interactive GIS map overlay of abiotic and biotic attributes for streams; reports from focus group and surveys in Hidalgo County; reports necessary to implement a large-scale composting operation to manage invasive aquatic plants; bi-national Rio Grande Institutional Database; high resolution rainfall estimates; multi-date land-cover classifications; summary of stewardship projects; GIS vegetation map for Brewster, Presidio, and Jeff Davis Counties with adjacent parts of northern Mexico; GIS vegetation change map of the Rio Grande and Terlingua Creek watershed; and grassland bird assessment evaluation.

### **What was accomplished under these goals?**

The overarching goal of the project is to create a basin-wide perspective for the sustainable use of water resources in the Rio Grande basin. Utilizing the diverse expertise of researchers from all the universities in the Texas State University System, this project focused on identifying and analyzing constraints to the sustainable use of this important transboundary water system, with the goal of developing real solutions that can be effectively implemented by land managers. Relevant project elements include characterization, quantification and modeling of the basin's surface and ground water resources; water supply-demand issues throughout the Rio Grande drainage basin, human health-related water pollution issues; vegetation mapping and modeling; grassland bird inventory; identification and characterization of the basin's biological integrity and aquatic habitats; an accurate and comprehensive database and clearinghouse of organizations and relevant research; a transboundary analysis for integrating results of this project; and, increased collaboration between land managers, governmental agencies, non-governmental organizations, and stakeholders.

Results include an increased understanding of the quantity and importance of the Edwards Trinity aquifer spring flow to the Rio Grande in the Lower Canyons reach above Amistad reservoir. Additionally, the overall understanding of the negative impacts of invasive species such as Tamarisk (salt cedar) and *Arundo donax* (giant river cane) particularly as they contribute to the lack of mobility of sediment in Boquillas canyon in Big Bend National Park. The overall degraded condition of this area is compounded by the effects of drought and upstream diversions. Results indicate that the relative quality of groundwater in the hyporheic zone (water in sand and gravel bars) varies within the Big Bend National Park reach of the Rio Grande. Results from the watershed study indicate that natural variation and anthropogenic impacts influence the physicochemical and biotic conditions across the Rio Grande/Rio Bravo del Norte drainage and these effects have implications for C sequestration, transformation, and transport, as well as for organic matter (OM) delivery to the Gulf of Mexico. The present study joins the growing body of work which demonstrates the importance of aquatic bacterial communities in the sequestration and transformation of both allochthonous and autochthonous C and the crucial role that bacterial community metabolism plays in ecosystem function at the landscape scale and beyond.

Climate: The atmospheric simulations and model performance evaluation achieved in this project show the climate forcing of the temperature, precipitation and air quality specific to the Rio Grande Basin region.

Management: Output from this SAWC project has been important to the State water planning process. We have included information from this SAWC project in the Senate Bill 3 (SB3) Rio Grande/Lower Laguna Madre and Upper Rio Grande Bay and Basin Expert Science Teams (BBEST 2012) environmental inflows recommendations report from July 2012. Three PIs on this SAWC Rio Grande project were appointed members of the SB3 Rio Grande BBEST, and SAWC information was applied to BBEST analysis of freshwater inflows requirements of the Rio Grande estuary and to water quality and quantity in the Rio Grande above Amistad reservoir. Salinity and nutrient loading regimes from our study were key datasets used in developing recommendations for BBEST environmental flows regimes.

Surface Water: An analysis of the impact of climate change on water and air quality was conducted; as well as analysis of atrazine in Rio Grande water and sediment. A baseline study of the hyporheic zone along the Rio Grande in Big Bend National Park was conducted.

Ecology: Inland freshwater ecosystems, though comprising a small portion of the earth's surface, are thought to be important in the global carbon (C) cycle. Carbon processing by heterotrophic microbes (bacteria) is a critical process, contributing considerably to overall ecosystem production and processing of dissolved organic carbon (DOC). A study of the Rio Grande Estuary has resulted in seasonal hydrographic surveys that have yielded temperature, salinity, dissolved inorganic nitrogen and phosphate, dissolved oxygen (DO), pH, and chlorophyll data that reflect the dynamics of a frequent salinity wedge and nutrient cycling processes in the tidal segment, dependent on the pulsed flow regime. Based on these results, this tidal segment of the river is characterized as ranging from mesotrophic to eutrophic.

**Invasive plants:** An invasive plant study was designed to investigate the effectiveness of a large-scale composting operation to manage invasive plants, water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), hydrilla (*Hydrilla verticillata*), and Georgia cane (*Arundo donax*), by rendering the seeds and other propagules non-viable while producing a valuable compost product for the agricultural and horticultural industries. This study demonstrated that the Delta Lake Irrigation Districts in the Rio Grande River Valley can harvest these invasive species as well as sludge weeds from the irrigation canals and incorporate them into a composting operation, not only maintaining the irrigation canals but making a profit from the waste materials that would otherwise end up in landfills as trash.

**Biology:** A generalized Trans-Pecos vegetation map was created using object-oriented classification. Maps such as these will help managers and biologists to identify areas of potential concern or interest for further studies.

**GIS:** A watershed mapping tool was developed to characterize the regional watersheds within the Rio Grande River Basin so that it can be used to both educate stakeholders and support the decision making process. This project has provided detailed summary data on the watershed characteristics that is amendable for both education and stakeholder outreach supporting watershed planning and water resource allocation decisions.

**Human Factors:** SHSU conducted two focus groups and administered a mail survey of water usage and issues in the lower Rio Grande Valley region. The focus groups were held in McAllen, Texas with primarily business and industry water stakeholders and representatives of water municipalities. The Rio Grande Water Master had a scheduling conflict with the focus groups and was interviewed separately. Following the focus groups, SHSU designed, translated into Spanish and administered a mail survey to residents of Hidalgo and Cameron Counties.

**Database and Clearinghouse:** Work has contributed greatly to a broader effort between the United States and Mexican governments to develop a Strategic Action Program for the basin, developed a clearer understanding of the social aspect on the U.S.-Mexico border, developed a clearer understanding of the variables affecting the management and administration of the Rio Grande's waters, developed a clearer understanding of the US government's role in managing and administering the Rio Grande's waters.

**Education and public outreach:** This project's goal is to strengthen the capacity of cities and educational institutions within the Rio Grande Basin Diagnostic Study Area to implement watershed protection programs by: 1) increasing environmental literacy among project participants; 2) supporting data collection; 3) promoting data sharing; and 4) fostering watershed stewardship. Results: This assessment resulted development of an ecoregion-based educational collaborative called the Chihuahuan Desert Ecoregion Educator Network (CDEEN). This program joins education and data collection programs from three institutions: water monitoring (Stream Team); species monitoring (Texas Parks and Wildlife Nature Trackers), and range monitoring (Sul Ross State University- "Warnock protocol").

### **What opportunities for training and professional development has the project provided?**

Seven workshops were conducted as follows:

August 2009- Full two-day CDEEN workshop at Big Bend Ranch State Park in which four Presidio ISD educators and three Sul Ross staff were trained in all three CDEEN programs.

October 2009- Half-day workshop at Presidio Valley Farms in which eight Presidio ISD Science Club Students, one Master Naturalist, and the Executive Director for the Trans Pecos Land and Water Trust were certified in the CDEEN water monitoring program.

March 2010-One-day workshop at the Trans Pecos Land and Water Trust Alamito Creek conservation property in which eight members of the Tierra Grande and Llano Estacado Master Naturalist Groups were certified in the water monitoring protocols

May 2010- One half-day workshop at Presidio ISD in which eight student members of the Presidio ISD Science Club completed retraining in the water monitoring protocols.

May 2010- One half-day workshop at CDRI in which the CDRI volunteer coordinator was certified as a Trainer in the CDEEN water monitoring protocols.

June 2010- Half day range monitoring workshop at CDRI in which participants completed a modified version of the Warnock range monitoring protocol.

August 2010- One-day workshop at Sul Ross State University and CDRI in which 19 individuals, including members of the Tierra Grande Master Naturalist group, were trained in the Amphibian and Horned Lizard Watch Program.

### **How have the results been disseminated to communities of interest?**

Through participation in various community meetings, workshops and regional water planning groups.

### **What do you plan to do during the next reporting period to accomplish the goals?**

{Nothing to report}

### **Participants**

{Nothing to report}

**Target Audience**

Researchers, universities, educators, students, natural resource managers, government agencies at all levels, non-governmental organizations, stakeholders, general public. The vision of the SAWC program is to link managers, planners, funding agencies, and university researchers with projects that provide a positive and cumulative benefit for ecosystem management at all levels within the Rio Grande Basin watershed.

**Products**

{Nothing to report}

**Other Products****Product Type**

Audio or Video

**Description**

"Confluence" video documentary about the Big Bend reach of the Rio Grande. The documentary was funded through our 2008 project and included projects from this grant.

**Product Type**

Databases

**Description**

Bilingual database of institutions and publications for the Rio Grande. Housed at Texas State University Meadows center (<http://www.meadowscenter-riogrande.org/>)

**Changes/Problems**

Groundwater study: We encountered problems with deployment of equipment in wells.

Surface water: chronic low water levels hampered numerous components of the project, including the hyporheic study, the Kokernot spring study and

Human factors: Despite multiple mailings, the response rate was extremely low with 103 usable surveys returned.