SOUTHERN SARE
Sustainable Agriculture Research & Education

Sustainable Crop/Livestock Systems in the Texas High Plains: Phase II

One can't talk about agriculture in the Texas High Plains without including "water" in the same sentence. The Ogallala Aquifer, which has kept ag production humming for nearly a century, is running low. Agriculture in the Texas Panhandle and Southern Plains is adapting to decreased water availability.

For nearly two decades, researchers and producers across the Texas High Plains have been developing integrated crop/livestock production systems that address the growing need for water conservation, while keeping soils fertile, crop yields profitable, cattle production thriving, and surrounding communities viable.

Funded through nearly $1.5 million in Southern SARE Research & Education, Large Systems, and Graduate Student grants, the results showcase long-term alternative production systems, and how those results are being translated into practical field production practices and sustainable agriculture applications.

This model of sustainable agroecosystems in the Texas High Plains is changing the face of agriculture in the region and helping to conserve water, improve soil health, boost ag profits and keep the High Plains region thriving for generations to come.

This bulletin highlights Phase II of SSARE-funded work from 2002-2005 (**LS02-131**, *Forage and Livestock Systems for Sustainable High Plains Agriculture.)*

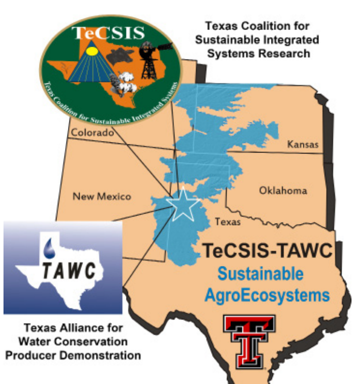

Photo credit: Texas Tech University

Introduction:

Crop and livestock production in the Texas High Plains generates over $8.7 billion in annual revenues but has been dependent on irrigation with water from the Ogallala Aquifer, which is now in rapid decline. With dependence on irrigated monoculture cropping practices and separation of crop and livestock industries, soil quality is declining. Alternative strategies that have fewer negative impacts on natural resources including water, soil, and air, but can maintain a viable level of economic profitability are essential if the Texas High Plains remains viable for agriculture. Diversified systems that include both crops and livestock have long been known for complementary effects that increase productivity and contribute to the conservation of natural resources.

Initial Southern SARE-funded research from Texas Tech University from 1997-2004 found that grazing stocker steers on perennial old world bluestem pastures and small grains in rotation with cotton required 25 percent less irrigation water and 36 percent less nitrogen fertilizer, and resulted in higher net cash returns/acre than growing cotton in monoculture. It was just as profitable to integrate systems as it was to grow monoculture cotton ($125 per acre profit for both systems) at a pumping depth of 300 ft. at the research site. This is important because greater water table depth simulates greater water scarcity. Therefore, the more scarce the water, the greater the justification to adopt an integrated production system. (See **LS97-082**, *"Sustainable Crop/Livestock Systems in the Texas High Plains"* for more information).

In the Southern SARE-funded project (**LS02-131**), *"Forage and Livestock Systems for Sustainable High Plains Agriculture,"* research continued into Phase II with the addition of dryland grazing systems and deficit-irrigated forage-livestock grazing systems.

Research Summary:

Additional production systems were added to the overall long-term research effort by Texas Tech University to demonstrate that diversified crop/livestock systems can be designed to conserve water and energy while maintaining or increasing economic returns over a monoculture crop production system.

Research Objectives:

The purpose of the project was to explore the effects the systems had on water demand in the region. Research objectives included comparing the productivity, profitability, input requirements, and impacts on natural resources of two forage systems for stocker steers with existing cotton monoculture and an integrated cotton/forage/livestock system.

In **System 1**, a non-irrigated three-paddock grazing system used a base pasture of buffalograss/bluegama/sideoats gama native grasses. Cotton and foxtail millett (a warm-season annual grass grown for supplemental grazing and weed suppression) were rotated annually in paddocks two and three. Steers grazed the native grasses and the summer annual grass.

In **System 2**, a deficit-irrigated three-paddock grazing system used WW-B.Dahl old world bluestem grass in the base pasture with 'Tifton 85' bermudagrass in paddocks two and three. Steers grazed the forages, and excess ungrazed forage was harvested for hay.

Non-irrigated dryland system. Photo credit: Chance Van Dyke

Research Results:

Phase I of the research served as the benchmark for comparison with the new systems tested in Phase II. The following information is not conclusive. **Research is ongoing and the systems are continually being refocused to address current, emerging issues.**

System 1: The non-irrigated dryland system provided grazing on native perennial grasses (sideoats grama, bluegrama, buffalograss, and green sprangletop) from May until about August. Cotton was grown in annual rotation with foxtail millet in the remaining two paddocks. Millet provided additional late summer grazing. Steers entered a feedlot for finishing at the end of the grazing season. No irrigation was used, either for establishment or for production.

Averaged over 5 years, steers gained about 313 lb or about 68 lbs/acre, and cotton yielded approximately 528 lbs/acre. Stocking rates averaged 0.23 steers/acre. Cotton yield average included 2 years of failed crops. Averaged over the years that produced a harvestable crop, lint yield averaged 880 lbs/acre. This system was highly vulnerable to weather and precipitation patterns.

System 2: In the deficit-irrigated grazing system, the bermudagrass/old world bluestem system required the longest time to become established. This 3-paddock, perennial warm-season grass system included 54 percent of the total area in old world bluestem with the remaining area equally divided into two paddocks of bermudagrass. Grazing was sequenced between the two paddocks of bermudagrass and bluestem until mid-August when grazing of bluestem was terminated. Steers completed the grazing season on bermudagrass and entered a feedlot by mid-October. Excess forage was harvested for hay. The bluestem was harvested for seed in October. Irrigation was limited to a maximum of 12 inches annually for bermudagrass and a maximum of 10 inches for old world bluestem. Steers gained about 440 lbs/per acre with approximately 8.9 inches of irrigation water applied.

Overall, the data from these experiments demonstrate that systems based on or inclusive of forages and livestock require less water for irrigation and livestock use than systems based entirely on monoculture cotton. How the system is configured, the forage species used, and the timing of grazing all impact total water required and economic profitability.

For a more detailed analyses of the research results, visit the national SARE projects database and search by project numbers **LS02-131**, *"Forage and Livestock Systems for Sustainable High Plains Agriculture,"* and **LS08-202**, *"Crop-Livestock Systems for Sustainable High Plains Agriculture."*

Deficit-irrigated grazing system of cattle on bermudagrass. Photo credit: Philip Brown

High Plains Water Conservation Resources

General Information

Texas Coalition for Sustainable Integrated Systems (TeCSIS)
http://www.orgs.ttu.edu/forageresearch/

Texas Alliance for Water Conservation
http://www.depts.ttu.edu/tawc/

TAWC Solutions
http://www.tawcsolutions.org/

Texas Water Development Board
http://www.twdb.texas.gov/groundwater/aquifer/majors/ogallala.asp

Texas High Plains Water District
http://www.hpwd.org/

USDA-ARS Ogallala Aquifer
http://ogallala.ars.usda.gov/

Publications

High Plains Water Conservation Bulletin No. 1: Water Conservation in the Texas High Plains

High Plains Water Conservation Bulletin No. 2: Sustainable Crop/Livestock Systems in the Texas High Plains Phase I

High Plains Water Conservation Bulletin No. 4: Sustainable Crop/Livestock Systems in the Texas High Plains Phase III

High Plains Water Conservation Bulletin No. 5: Diversifying in the Texas High Plains

High Plains Water Conservation Bulletin No. 6: Agroecoystems Economics in the Texas High Plains

High Plains Water Conservation Bulletin No. 7: Soil Quality of Integrated Crop/Livestock Systems

High Plains Water Conservation Bulletin No. 8: Texas Alliance for Water Conservation

High Plains Water Conservation Bulletin No. 9: Water Use of Old World Bluestems in the Texas High Plains

High Plains Water Conservation Bulletin No. 10: Cover Crops and Cotton in the Texas High Plains

High Plains Water Conservation Bulletin No. 11: Agroecosystems Research in the Texas High Plains

Grant Projects

GS15-152 Evaluation of Winter Annual Cover Crops Under Multiple Residue Managements: Impacts on Land Management, Soil Water Depletion, and Cash Crop Productivity

LS14-261 Long-term Agroecoystems Research and Adoption in the Texas Southern High Plains: Phase II

LS11-238 Long-term Agroecosystems Research and Adoption in the Texas Southern High Plains: Phase I

LS10-229 Integrated Crop and Livestock Systems for Enhanced Soil Carbon Sequestration and Microbial Diversity in the Semiarid Texas High Plains

LS08-202 Crop-livestock Systems for Sustainable High Plains Agriculture

LS02-131 Forage and Livestock Systems for Sustainable High Plains Agriculture

GS07-056 Allelopathic effects of small grain cover crops on cotton plant growth and yields

GS02-012 Optimizing Water Use for Three Old World Bluestems in the Texas High Plains

LS97-082 Sustainable Crop/Livestock Systems in the Texas High Plains

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