SOUTHERN SARE
Sustainable Agriculture Research & Education

Agroecosystems Economics in the Texas High Plains: A 10-year analysis, 1999-2008

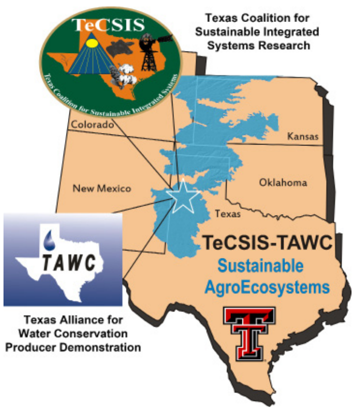
One can't talk about agriculture in the Texas High Plains without including "water" in the same sentence. The Ogallala Aquifer, which has kept ag production humming for nearly a century, is running low. Agriculture in the Texas Panhandle and Southern Plains is adapting to decreased water availability.

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 focuses on 10 years (1999-2008) of economic analyses from SSARE-funded work, (**LS97-082**, *"Sustainable Crop/Livestock Systems in the Texas High Plains."*



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Introduction:

The Texas High Plains, a semi-arid region of the state's panhandle, has enjoyed nearly a century of crop farming dominated by a cotton monoculture (about 25 percent of the U.S. crop) and made possible by tapping into the Ogallala Aquifer for water. Alternatively, stocker cattle enter the region primarily to graze wheat and other forages before entering area feedyards where about 25 percent of U.S. cattle are finished annually. Little integration of these industries has existed historically.

But, according to the U.S. Geological Survey, the Ogallala Aquifer is drying up. As water resources continue to dwindle across the Texas High Plains, crop producers and ranchers in the region are faced with a growing challenge: Adopting an ag production system that not only saves water and is environmentally friendly, but is also profitable.

Based on long-term research supported by Southern Sustainable Agriculture Research & Education (SSARE) grants, Texas Tech University scientists may have an answer: Diversified ag production systems of crops, forages and livestock.

Based on 10 years of Texas Tech University research, integrated cotton-forage-beef cattle systems are just as profitable as cotton monoculture systems. But there's more. Integrated crop-livestock systems use less irrigation water, are more energy efficient, preserve soils by reducing wind erosion, and have a lower economic risk related to specific loss events, such as a drought.

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The economic analysis is based on the results of a SSARE-funded grant (**LS97-082**), "*Sustainable Crop/ Livestock Systems in the Texas High Plains*." Details of the economic evaluation were published in Agronomy Journal, "*Integrating Cotton and Beef Production in the Texas Southern High Plains: An Economic Evaluation*."

Research Objectives:

The objective of the study (conducted from 1999-2008) was to assess the economics of two production systems – an irrigated cotton monoculture system and an irrigated cotton-forage-beef cattle system – based on overall profitability, economic risk, water use efficiency, and energy use efficiency. The integrated crop-livestock system consisted of a paddock of WW-B.Dahl old world bluestem (a perennial warm-season grass), and two paddocks of a rye-cotton-wheat-fallow-rye rotation.

Annual detailed cost and return budgets were prepared using input and output prices for each year and mean values for input and output prices from 1999-2008. Examples of inputs included irrigation, cottonseed, herbicide and fertilizer. Examples of outputs included cotton lint, cottonseed, perennial warm-season grass seed, and the value of livestock weight gain.

Research Results:

Economics

Over the 10-year period, the systems were similar in profitability. Cotton lint yields were similar within each system over the 10 years with mean yields of 1,219 lb/acre (1,367 kg/hectare) for cotton monoculture and 1,231 lb/ acre (1,380 kg/hectare) for the cotton rotation within the integrated system. The cotton monoculture system had a 10-year mean gross margin of $94 per acre ($233 per hectare) compared to $92 per acre ($228 per hectare) for the integrated system.

But there were differences within the 10-year study period. The integrated system was more profitable during the first 4 years of the study (1999-2002) with a mean gross margin of $48 per acre ($120 per hectare) compared to $34 per acre ($84 per hectare) with cotton monoculture. Ninety-two percent of the integrated system's gross margin was contributed by the livestock-forage component. Based on actual price scenarios, the integrated system had a mean gross margin of $55 per acre ($137 per hectare) compared with $7 per acre ($18 per hectare) for cotton monoculture.

However, from 2003-2008, the systems flipped. The cotton monoculture system was more profitable, with a mean gross margin of $180 per acre ($445 per hectare) compared to $121 per acre ($300 per hectare) for the integrated system. Based on actual price scenarios during this time period, the cotton monoculture had a mean gross margin of $188 per acre ($466 per hectare) compared to $136 per acre ($337 per hectare) for the integrated system.

When factoring in reduced tillage costs, gross returns of the integrated system were 38 percent greater than the gross returns of the monoculture system.

Researchers speculate that the increased profits in cotton monoculture coincided with the introduction of higher yielding cotton cultivars. However, the contribution of cotton also increased profits in the integrated system, suggesting that the introduction of higher yielding cotton cultivars increased the profitability of both systems. Cotton represented 100 percent of the monoculture system while it represented only 23 percent of the integrated system. Also, the study was conducted during a time when cotton prices were relatively high while cattle prices were relatively lower compared with today's prices.

Irrigation

Twenty-four percent less irrigation water was applied to the integrated system than to the cotton monoculture system. The introduction of higher-yielding cotton cultivars increased irrigation-use efficiency for both systems, but under the actual price scenario, the integrated system had a greater irrigation-use efficiency compared to the cotton monoculture system.

This suggests that the integrated system can be just as efficient in water usage as the cotton monoculture system, but requiring less irrigation overall. The integrated system could be a viable alternative in areas of the Texas High Plains region were irrigation is limited, or where water availability continues to decline.

Energy Use

The two systems were compared in total energy usage, which included direct and indirect energy. Direct energy included diesel fuel used for tillage, electricity for irrigation, fabrication, packaging, transportation of inputs, and livestock. Indirect energy included energy to produce fixed assets like tractor implements and irrigation equipment, and energy to produce calves that entered the integrated system.

Results showed that the cotton monoculture system used more energy than the integrated system. A comparison of cotton production on a cropland area basis showed that cotton included in an integrated system used less energy (43 percent) than cotton monoculture (52 percent). Irrigation contributed to the largest energy use for both systems.

Research Summary:

Where water availability is adequate, the cotton monoculture system can be more profitable than the integrated system. However, in areas were water is limited or declining, diversifying an ag production system with cotton, livestock and perennial warm-season grasses provides a profitable alternative.

In addition, an integrated system reduces economic risks associated with weather events, such as drought and storm damage. Wind erosion is potentially reduced 90 percent in an integrated system compared to a monoculture cotton system, and an integrated system has non-market benefits, including reduced fertilizer requirements, improved wildlife habitat, increased soil microbial diversity, and increased soil organic carbon.

These benefits compounded have the potential to economically and environmentally sustain a region struggling to support monoculture cropping systems.

Photo credit: Texas Tech University TeCSIS

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

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. 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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