



Diversifying in the Texas High Plains: Examples of agroecosystems models

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 examples of agroecosystems configurations that have been studied across the Texas High Plains since 1997.



Photo credit: Texas Tech University

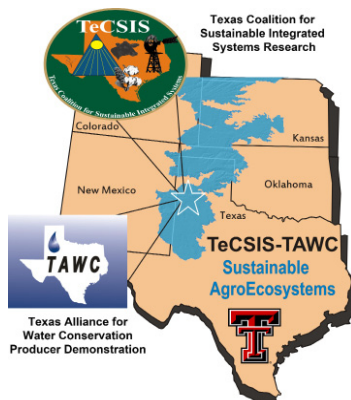
Introduction:

Over the past century, agriculture on the Texas High Plains has evolved into a \$20 billion-plus industry centered largely on cotton and finishing beef cattle in feedlots. Agriculture was made possible with fertile soils, cheap energy and fertilizers, and irrigation water from the Ogallala Aquifer – a crucial, but finite resource deep below the soil surface stretching from South Dakota to the Texas Panhandle.

With energy and other resource costs rising, and water declining in the Ogallala Aquifer, farmers are at a crossroads: Continue current unsustainable practices, or make cropping choices that conserve energy, improve soil and prolong the use of water remaining in the Ogallala.

For two decades, researchers at Texas Tech University have embarked on a journey of research, education, and outreach – funded, in part, through Southern SARE grants -- to test alternative production systems that have the potential to keep the region economically viable and environmentally sustainable.

Taking a "systems research" approach, researchers – backed by a over a decade of producer-driven field studies -- have compared cotton monoculture to diversified crop/livestock systems. What they have found is that systems based on or inclusive of forages and livestock require less water for irrigation and livestock use than systems based entirely on row crops.



At the same time, no one system fits all. How the system is configured, the crop and forage species and varieties/breeds and stage/production used, and the timing of grazing all impact total water required and economic profitability. As issues arise, trends emerge, and the face of agriculture changes, production systems in the Texas High Plains must be modified and revised to fit a specific farmer's situation.

System Configurations:

The following system configurations are examples of the diversified crop/livestock production practices that have been studied across the Texas High Plains since 1997. These systems have been tested against cotton monoculture—a subsurface drip-irrigated system farmed with conventional cultural practices recommended for the High Plains region.

Integrated cotton-forage-livestock system

This 3-paddock system included about 54 percent of the area established in WW-B.Dahl old world bluestem with the remaining area equally divided in a 2-paddock alternate rotation of cotton/wheat/and rye. Following graze-out of rye, cotton was no-till planted into stubble, and cattle moved to wheat in the alternate paddock. Old world bluestem was harvested for seed in autumn. Wheat was no-till planted into



Integrated cotton-forage-livestock system. Photo credit: Vivien Allen

cotton following harvest in November while rye was planted into the alternate paddock in September after graze-out of wheat and a summer fallow period. Cattle entered the system in January to graze dormant old world bluestem and rye as available. Following graze-out of wheat, cattle returned to summer graze old world bluestem until mid-July when they entered the feedlot for finishing.



Non-irrigated integrated cotton-forage-livestock system. Photo credit: Philip Brown

Non-irrigated integrated cotton-forage-livestock system

This 3-paddock system provided grazing on native perennial grasses (side-oats 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.

Deficit-irrigated grazing system

This 3-paddock, perennial warm-season grass system included 54 percent of the total area in WW-B.Dahl old world bluestem with the remaining area equally divided into two paddocks of Tifton 85 bermudagrass. Grazing was sequenced among the two paddocks of bermudagrass and bluestem until mid-August when grazing of bluestem was terminated. Steers completed the graz-

ing season on bermudagrass and entered a feedlot by mid-October. Excess forage, if present, 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, which still resulted in a soil moisture deficit in relation to summer-long crop water demand.



Deficit-irrigated grazing system. Photo credit: Philip Brown

Buffer-irrigated integrated cotton-forage-livestock system

The non-irrigated integrated cotton-forage-livestock system described above was buffered from drought by inclusion of one paddock with forage that could be irrigated in times of extended drought. This provided the options to continue grazing rather than having to 'sell' cattle. Thus, the non-irrigated system was revised to include an adjacent paddock of WW-B. Dahl old world bluestem (approximately 20 percent of the total system). The grass was deficit irrigated to supplement grazing. Steers entered a feedlot for finishing at the end of the grazing season.

Forage-finishing system

This 4-paddock system attempted to take weaned Angus calves to a finished weight and grade on pasture. The original 3-paddock integrated crop-livestock system was revised: WW-B. Dahl old world bluestem was overseeded with biennial yellow sweetclover and alfalfa; Jose tall wheatgrass and alfalfa replaced one of the small grain/cotton



Buffer-irrigated grazing system. Photo credit: Philip Brown

rotation paddocks; and a native grass mixture replaced the other paddock in the cotton/small grain rotations.

Additionally, the paddock previously used for continuous cotton was included with this system to provide additional grazing of a forage sorghum monoculture. Each of the forage mixtures and the forage sorghum was limit-irrigated but the native-grasses were only irrigated in extreme conditions. Steers were supplemented with dried distillers grains from the ethanol industry to increase energy and protein beginning mid-summer. Steers sequence grazed the three forage mixtures from May to October then entered the feedlot for finishing if a finished weight and grade were not accomplished on pasture.



Forage-finishing system. Photo credit: Lisa Baxter

Crop monoculture forage sorghum for silage

This non-grazed system, located in a caged area of the former continuous cotton system, was a forage sorghum monoculture harvested for hay or silage that could supply feed to the dairy or feedlot industries. This area remained ungrazed from the beginning of the systems research in 1997. Hairy vetch was seeded in autumn as a winter-spring cover crop, followed by spring no-till seeding of sorghum into terminated vetch in the spring. Then vetch was overseeded back into sorghum stubble the following autumn.

Summary:

This research has created a greater awareness of the need for water conservation and has provided a 'reality check' on water needs of various crops and systems. Producers are adopting components that fit their goals and individual systems, and are thus moving toward a more integrated strategy to match water with fertility to target realistic yield goals rather than maximum production.

Farmers are weighing new diversified cropping options because of the Ogallala decline, and thus looking to this ongoing research for answers on establishment methods, irrigation rates, expected levels of forage quality and cattle weight gains, and costs and returns.



Forage sorghum under center pivot. Photo credit: Rick Kellison, Texas Alliance for Water Conservation

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. 6: Agroecosystems 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 Agroecosystems 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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