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South Dakota State University Agricultural
Experiment Station

Summer 6-21-1999

Farm and Home Research: 50-3

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Recommended Citation

Tennyson, Larry; Leslie, Jerry; Lammers, Jaimi; and Misar, Stephanie, "Farm and Home Research: 50-3" (1999). *Farm and Home Research*. Paper 3.

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Farm & Home RESEARCH

South Dakota State University • College of Agriculture & Biological Sciences • Agricultural Experiment Station

Volume 50 • Number 3

Summer 1999

Northeastern South Dakota basins flood

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Change is the 'norm' in agriculture.
It is our challenge to mold the future to our needs.

Director's comments

by Kevin Kephart

We have seen another summer and another growing season come and go. The 1999 wheat crop is in the bin; yearlings are in the feedlots. Corn and soybeans are out of the fields. This is the part of South Dakota agriculture that never changes—the harvest after the planting, the mature animals from the breeding and calving.

Yet South Dakota agriculture is anything but unchanging. It is driven by environment, markets, federal policies, pronouncements out of the European Union, crop forecasts from Argentina, new technology in the equipment dealers' lots and in our computers.

Change also happens at the South Dakota Agricultural Experiment Station (SDAES). This summer I accepted the

leadership of the SDAES, becoming only the tenth director since 1887 in a station located in the nation's most agricultural state. It is an awesome responsibility and a great honor to be able to serve my fellow citizens.

Other changes have occurred in our College of Agriculture and Biological Sciences (ABS) administration. Colleague and friend Larry Tidemann is

Farm & Home RESEARCH

Volume 50 • Number 3 • Summer 1999

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Published quarterly by the Agricultural Experiment Station, College of Agriculture & Biological Sciences, South Dakota State University, Brookings, South Dakota. Sent free to any resident of South Dakota in response to a written request.

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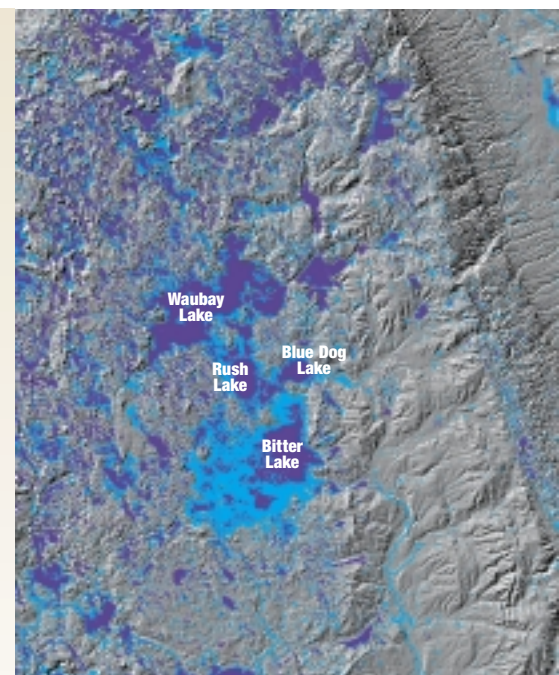
Photos in this issue were contributed by Tom Bare, Les Flake, Tom Harrington, Tom Holmlund, Glenn Kelly, Jerry Leslie, Curt Vacek, and Mike Volek.

South Dakota Farm & Home Research is edited and designed in the Department of Ag Communications, SDSU, and printed on campus at the SDSU Printing Laboratory with AgriTek ink, containing soy, corn, and other vegetable oils.

<http://www.abs.sdstate.edu>

Published in accordance with an act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agricultural College and with the act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University. South Dakota State University is an Affirmative Action/Equal Opportunity Employer (Male/Female) and offers all benefits, services, education and employment opportunities without regard for ancestry, age, race, citizenship, color, creed, religion, gender, disability, national origin, sexual preference, or Vietnam Era veteran status.

???? printed by the AES at a cost of ??¢ each.



About the Cover: Dark blue is "current" water level. Light blue shows theoretical "worst-case scenario": all basins filled with water to the point of spilling over. Note that Bitter Lake would be much bigger before eventually flowing into the Sioux River. Image courtesy of Glenn Kelly, EROS / USGS.

now director of the South Dakota Cooperative Extension Service. Both Larry and I are committed to a harmonious and seamless effort to reach all South Dakotans with new and useful knowledge. You may have noticed already in your *Farm & Home Research* magazine how we include Extension specialists and students in our stories. The reason is very plain: Our scientists do not conduct their research in isolation; in fact, most of them also carry Extension appointments and teach in our classrooms. And many of them have shaken hands with you at field days, plot tours, or in other meetings across the state. The SDAES benefits from every one of these contacts with you.

We also have had a most unhappy change in the ABS College. Gene Arnold, who directed Academic Programs since 1985, has died after a 2-year fight with cancer. Gene was the single-most important mentor for all of us in the current administration, but his gentle influence extended back through the years he was a teacher and weed scientist. It is in the lives of his hundreds of former students where his presence (and absence) is felt most. I wish to extend the condolences of the SDAES to Gene's wonderful family. His College family misses him dearly.

A scholarship endowment has been set up in Gene's name, with the proceeds from the endowment offered to worthy and needy students in the ABS College. Contributions may be made to SDSU Foundation—Gene Arnold Scholarship. Letters of how Gene helped your education and career are also welcomed.

This year's issues of *Farm & Home Research*, in celebration of 50 years of pub-



Kevin Kephart, second from left, visits with (l to r) Gary Haiwick, Highmore area rancher and former chairman of the station's board of directors, Ken Wonnemberg, Hyde County Extension educator, and Doug Hageman, DVM from Highmore, at the station's 100th anniversary field day.

lication, have focused on historical themes, the work of some of our most notable scientists, and the changes wrought over the years as their discoveries were applied to South Dakota farms and ranches.

In this issue, however, we put the spotlight on a place, the Central Crops and Soils Research Station. This year marks the centennial of the Highmore Research Farm, the first research farm of its kind in the northern Great Plains.

The Highmore highlights, as described in a following story, show the changes the SDAES has introduced into central South Dakota and the multi-state region. Look at the pictures for more examples of change.

The mission of the farm never changed, however: to investigate and make available the best of drought-resistant crops to farmers who so desperately need them. The farm has remained faithful to that 1899 goal. But, because

additional work was requested by farmers, change occurred in the way we carried out that mission, as small grains, weed control, soil fertility, alternative crops, and trees were added to the original forages first studied.

Much like the Highmore Research Farm, this issue of our magazine is faithful to its long-held responsibility of bringing you research results you can use in your own pursuits. In that light, an issue would not be complete without an encouragement to you to provide your comments to us.

We are on the brink of changes in agriculture that could shake our lives to the core. Now, as at no other time in the past, we must communicate and cooperate with each other. We all must face the uncertainty of the 21st century; let us go forward together. Let us hear and respond to your concerns. ❖

Highmore highlights

The very first field station in the northern Great Plains celebrates its centennial

by Mary Brashier



Hyde county farmers surely must have congratulated Frank Drew of Highmore when he donated 117 acres of land to the South Dakota Agricultural Experiment Station in 1899.

For one thing, they were grateful. Droughts in the 90s were thinning out the less hardy farmers and overstretching the resources of the remaining ones. They'd asked State College in Brookings to build a local experiment farm but only federal money was available, and that couldn't be used. They'd put pressure on the State Legislature, which authorized the venture but failed to appropriate any money for it.

Drew, Highmore bank owner, would naturally understand their needs. Periodic droughts would keep Hyde County from prospering. The country was dry, wind-blown, and experienced deep low temperatures in winter and searing highs in summers, yet it was well suited for cattle, if the feed held out.

So he wrote a stipulation into the contract: Before he'd hand over the deed, he would have to be assured the research station would be used to study "drought resisting forage crops."

While Hyde County farmers saw this as a welcome step to stability, there probably still were whispers. "Look what he did. He got rid of that worthless piece of ground."

Depending on who was talking, the new experiment station north of the railroad tracks at Highmore was the poorest land in the township, maybe even in the county. Its former owner had let it go for taxes.

At the October 1887 tax sale, Drew and two others were the high bidder for this undeveloped property and several

other parcels of land; the total tax due for the package was \$54.69.

The other men soon sold their interests in the acreage to Drew and his wife Lillie who in 1899 donated it to the Experiment Station. Perhaps prodded by this public-spirited gesture, the Hyde County commissioners chipped in \$600 to build a seed and tool shed and appointed a committee "to supervise the fitting up of the grounds."

If forages would grow on the new Highmore experiment farm with its poor soils, they would grow anywhere else in the county.



In 1907, the State Legislature appropriated \$8,000 for a barn, seed house, and residence, even though the superintendent had offered to sleep in the seed house. Lower picture is as buildings appeared in 1919.

Over the ensuing 100 years, the gift Frank Drew gave Hyde County grew to enormous proportions. That "poor" parcel of land, never enlarged past its original 117 acres, was the very first research farm in the north-central U.S. and today is known as the premier "stress station" for the semi-arid portions of the northern Great Plains. Highmore is the environmental test; as they said back in 1899, if it grows at Highmore ...

Forages could grow at Highmore. Needed were ones that could withstand drought.

1899: Thirty grass and clover plots were planted. Turkestan alfalfa, brought from Russia by USDA Plant Explorer and State College Professor N.E. Hansen, Brookings, was seeded and tested for the next 15 years.

1901: The first grass breeding project in South Dakota sought to find a superior variety of smooth brome grass, which had already showed high yield, drought resistance, and winter hardiness at the station.

1902: Green needlegrass, western wheatgrass, and smooth brome grass showed promise for range renewal. Annual sorghums had value as winter feed and during drought.

1904: The annual report listed 200 small plots of grasses and clovers started in the

In 1912, Sam Garver, station superintendent, spotted an odd characteristic in some yellow-flowered alfalfas. The roots "crept," up to 3 feet from the parent plant before putting up new shoots. The trait was incorporated into a pasture alfalfa, 'Travois.'



search for drought resistant species. The Turkestan alfalfas from 1899 were producing up to 1½ T/A of hay. Hay from four millets went well over 2 T/A.

1906: Alfalfas and clovers on the South Dakota frontier are rich in "flesh-forming food, and when fed in conjunction with our highly carbonaceous grains, such as corn and barley, furnish a better balanced ration for live stock than when fed native prairie hay" (James W. Wilson in AES B 94).

1907: Variety testing of 20 alfalfas from other regions of the country was started in cooperation with USDA.

1907: "More work in plant breeding has been done with the foxtail millets at the Highmore Station than with any other one crop" (W.A. Wheeler in AES B 101).

1911: Starting in the fall of 1910 and into 1911, rain and snow were unusually scanty. In the summer came blister beetles and grasshoppers. "Seasonal conditions at Highmore for 1911 have been the most severe since the establishment of experiments there." Yet, alfalfa "has demonstrated that it can produce a fair crop when all other hay crops fail" (Samuel Garver, annual report).

1912: Garver began to notice a "peculiar root system" on a yellow-flowered alfalfa (*Medicago sativa falcata*) variety that had been grown at Highmore ever since brought to the U.S. by Hansen. Some roots extended 2½ to 3 feet from the parent plant before sending shoots to the surface. After WWII this valuable characteristic was incorporated into the grazing type alfalfa "Travois,"



1913, date of this picture, was the third year of a severe drought in the Highmore area. Worse yet, the previous winter had been open and dry. Sweetclover plots managed to survive but stands were thin. Purple-flowered alfalfa plots were also in bad shape; yellow-flowered alfalfas fared better.

released in 1963 after extensive testing at Highmore under intensive grazing pressure (Garver, annual report).

1913: The third year of a severe drought, combined with an open, dry winter and alternate freezing and thawing in the winter caused alfalfa and clover stands to thin out. The *falcata* alfalfa survived the beastly weather in good shape. The purple-flowered alfalfas suffered severely.

1914: 'Cossack' and 'Ladak' alfalfas, tested at Highmore, were released.

1936: A forage sorghum low in hydrocyanic acid was selected at Highmore by the simple method of turning a cow into the plots. She thrived, the sorghum and a selection from it called 'Rancher' were the first low prussic acid varieties in the U.S., adding millions of dollars to the forage economy.

1940s: The smooth bromegrass variety 'Homesteader' was released.

1947: Early growth of *Kochia scoparia* is leafy, palatable, and nutritious. It grows abundantly when lack of moisture limits more familiar forages. It is grasshopper resistant and high in protein. In a pinch it would make highly adequate hay or silage.

1956: "Grass-alfalfa mixtures will on the average yield about twice as much as grass alone, and this differential will tend to increase each succeeding year" (Jim Ross in AES C 124).

1957: The high forage and seed yields of a new intermediate wheatgrass were first recognized at Highmore. Named 'Oahe,'



In 1912, every month except February and May was short in moisture. Hot winds in July wiped out any gains May rains gave. Shown here is "edge effect," more robust alfalfa plants along the outside of the plot because of additional moisture to the roots from the cultivated ground on the left. If rows instead of broadcast plots had been planted, Sam Garver said, the estimated hay yield would be off.

this large-seeded and highly productive strain was released in 1962.

Small grains projects soon enlarged the scope of research. Hardly a variety was released by the Agricultural Experiment Station that was not tested at Highmore:

1904: The season "was practically perfect for growing durum wheat." Kubanka 5639 was far and away the best of the varieties, "while the inferior sorts should be relegated to the elevators" as quickly as possible (James H. Shepard in AES B 99).

1904: Tests were run on 47 macaroni

wheats, 2 bread wheats, 2 emmers, 6 oats, 26 barleys, "all showing admirable qualities" (W.A. Wheeler in AES B 84).

1913: Tests of winter wheat began.

1919: Edgar S. McFadden was put in charge of cereal investigations at Highmore. Getting nowhere increasing seed from his Marquis-emmer cross, he harvested and threshed everything in bulk and grew a "mixed population for several generations to give promising types a chance to make their appearance." 1919 was a bad rust year, giving him the opportunity to separate resistant and susceptible types. "Only a fraction of



Early attempts to encourage trees were not successful, but 1940s plantings of windbreaks, orchards, and ornamentals survived, as shown in these aeriels, dates unknown. From a barren, windswept prairie farmstead, the station has become a showcase and regional testing site for dryland woody plants.

one percent of the original bulk seed remained, but between four and five thousand plants were grown from it in 1920. About 100 of the more promising plants were selected and tagged for further study. All of these selections, except six which appeared to be true wheats, were eventually discarded" (McFadden, speech). He and his family lived in the seed house for the 2 years they spent at Highmore. When federal appropriations were cut, the McFaddens moved back to his farm in Day County where he continued his work that led to rust-resistant 'Hope' wheat, parent stock widely used in breeding new rust-resistant varieties.

1932: A 19-year summary identified adapted varieties of spring, winter, and durum wheats, emmer, oats, flax, barley, winter rye, and millet.

Corn and sorghum were first grown in the Highmore area as fodder:

1900: The area was noted for its high winds which blew the corn about, but scientists grew the crop successfully.

1913: 'Dakota Amber Cane,' selected at Highmore, contributed greatly to the forage economy for more than 50 years.

1930s: After the hybrid corn breeding program was established at Brookings, Highmore became the major testing site to select hybrids of the same maturity at Brookings but with better adaptation for the lower rainfall areas of the state.

1940s: 'Norghum' and 'Reliance' sorghums were released after extensive tests at Highmore.

1970s: Thirty inbred lines of corn selected for stalk rot resistance, as indicated by stalk strength, were released after testing at Highmore.

Crop management studies help farmers increase and stabilize their economic returns:

1905: Sixteen plots were prepared to test different tillage practices against alternate cropping and summer fallow. "This line of work is very much needed in the region represented by the Highmore Station" (W.A. Wheeler in AES B 96).

1932: A 19-year study showed the most efficient crop sequence to be a cultivated crop-small grain-legume. The order of se-

quence was more important than the specific kind of crop itself.

1955: When wheat was grown continuously from 1942 to 1955, yields decreased as much as 9 bu/A. With fallow or sweetclover fallow, yields remained essentially the same. Adding a row crop in the rotation increased wheat yield "considerably" over continuous wheat (B.L. Brage in AES C 124).

Windbreaks and orchards bring shelter and add beauty to the prairie:

1901: Russian wild olives and Siberian pea trees were set out near the old seed house. Russian olive was not a very thrifty tree in the central South Dakota plains.

1942: The first of windbreak, orchard, and ornamental trees and shrubs were planted. Before this the farm was almost treeless. "Most wild fruit has disappeared at a rate faster than it has been replaced by domestic plantings" (P.E. Collins and S.A. McCrory in AES C 124).

1965: The station became part of the regional testing program for woody ornamentals in which 6 to 20 varieties of ornamental trees and shrubs continue to be planted every year under dryland conditions. The station is a showcase of shrubs and trees best adapted for use in landscape plantings and tree belts in central South Dakota.

The farm, first research farm in the north-central U.S., is an integral part of its community. It began under the name of Co-operative Range Experiment Station in 1899

because of an operating agreement between the Experiment Station and the USDA, changing to the Highmore Substation in 1906. In 1948 it became the Central Substation. In 1972 its present formal name of Central Crops and Soils Research Station was adopted. Most Hyde County residents still call it the Highmore Experiment Farm, however. People still talk and write about:

1902: Arrangements were made to fence a pasture and build a barn for the work team. A sulky cultivator and a seed cleaner were purchased, but Superintendent D.A. Saunders would have to wait for the subsoil plow and two-horse grain drill.

1906: "The work of the Station has been seriously handicapped for the past three years by the inadequate buildings and equipment of the Station. Thousands of varieties and selections of seeds grown during the past year are stored in a shed where they are likely to be destroyed by pests, or lost at any time. ... The building that is needed above all others is a seed house for the storing and handling of seeds and plants" and which would furnish a "sleeping room for the superintendent" (W.A. Wheeler in AES B 96).

1907: The State Legislature appropriated \$8,000 for buildings, and the house, seed house, and a second barn were built. The 1½ story house has been a residence for the station superintendent ever since.

1907: "Where transportation charges are high and the price of grains are low as is the case in the Northwest the cattle feeding proposition should be thoroughly consid-



"Highmore results are worth using as a basis for farming operations" (A.N. Hume in AES B 272). Date of this crop tour is 1925.

ered before shipping both grain and stock to the market separately" (James W. Wilson in AES B 100).

1918: "It is doubtful if any similar stations in the country could be cited that carry any greater number of [plot experiments] with the use of limited funds. This is especially true at Highmore ... It is not possible to over-estimate the benefit which the several sub-stations have been and will be to South Dakota" (A.N. Hume, annual report).

1930s: Highmore saw complete crop failures in 1933, '34, and '36 because of drought. Grasshoppers were an additional stress; 12,000 tons of grasshopper poison were spread in Hyde County in 1934, according to the Historical Society. Moderate rust infestations came in 1935, '37, and '38. Dust storms and forced destruction of cattle herds are still painful memories for old-timers. In 1936, CBS radio broadcast from Highmore, the heart of the drought area. What goes around ... in 1976, national television came to Highmore for the same reason.



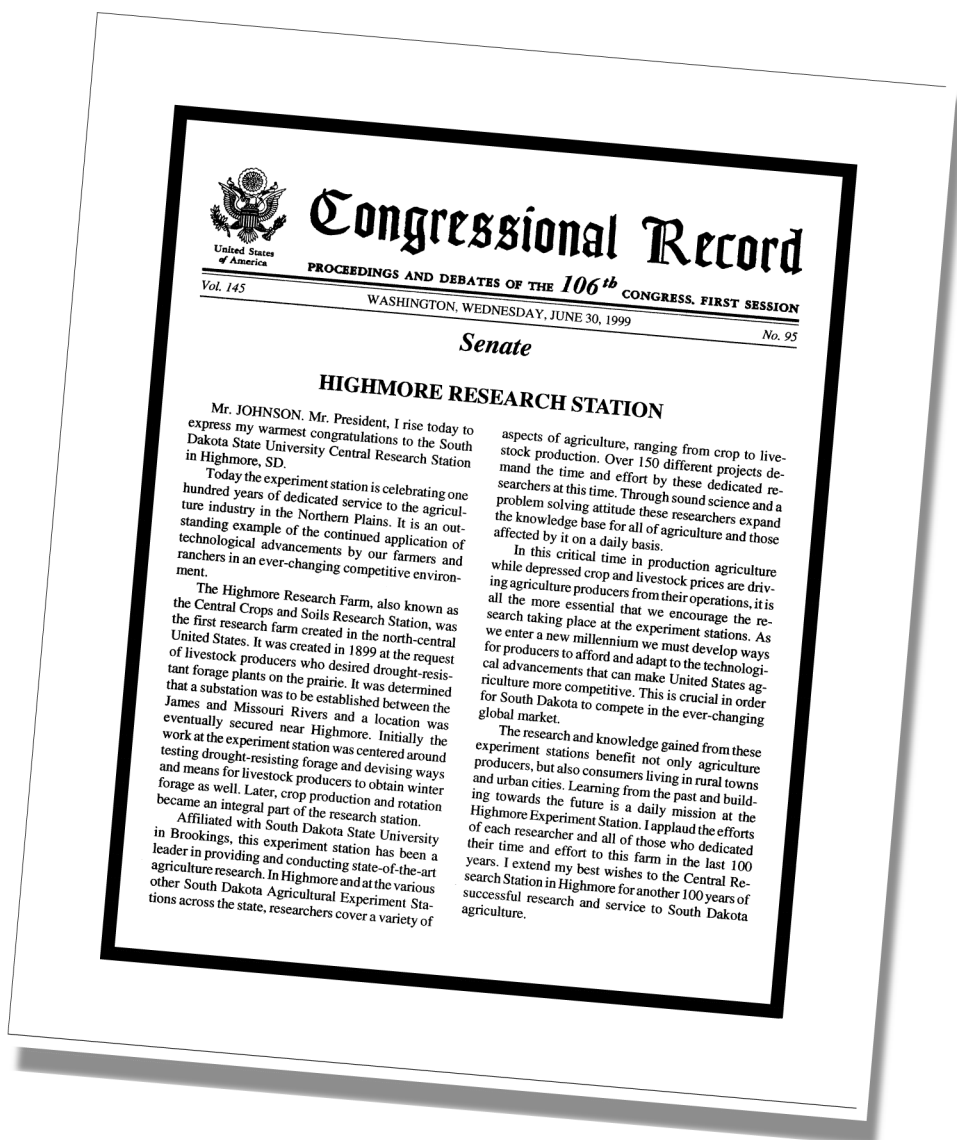
1995: The station recorded 33.04 inches of precipitation. The 1991-95 average was 26 inches per year, collectively the wettest period on record (17.5 inches of precipitation was an "average year"). In 1996-97, one of the coldest and snowiest winters in history, the station recorded 83 inches of snow from October to April.

1998: Mike Volek, farm superintendent who came to work at the Station out of high school in 1971, was elected Hyde County sheriff. His wife Dixie is on the city council.

1999: Brad Farber, farm manager, is on leave to pursue another scientific project. Arvid Boe, forage breeder at SDSU, will fill in as temporary manager until Farber's return.

And what happened to Frank Drew? He won a seat in the South Dakota Senate for the 1891-92 term. In 1893 he returned to Wisconsin, the state of his birth, and established a bank in Tomah. He kept his South Dakota connections, however, owning the Highmore bank in partnership with his brother Socrates. Drew relatives continue in the state. ❖

Material for this story was compiled from interviews with Brad Farber and Mike Volek of the Highmore Station, John Awald of the Agricultural Heritage Museum, Brookings, and from Agricultural Experiment Station (AES) bulletins (B), circulars (C), and annual reports and several Hyde County histories.



Its mission is 100 years old; its future is continued service to the people of the northern Great Plains

The Highmore farm, our 'stress station'

by Mary Brashier

It is work as usual this year as the Highmore Research Farm turns 100.

Scientists with projects at the farm, more formally called the Central Crops and Soils Research Station, hold to the goals their predecessors set a century ago: to use the 117 acres to help area farmers persist through the windy, droughty years that come so often to central South Dakota.

For some of the SDSU scientists writing in the 1999 annual report, it was a little difficult to describe their work as "drought research."

Some of Jackie Rudd's wheat lodged because of high fertility and ample moisture.

Vance Owen's emergency crops—so named because they are planted after other crops fail in a dry year—"were drowned out a couple of times."

On the other hand, a little extra rainfall gave Jim Gerwing a chance to work on how wet years affect rooting patterns in his long-term fertilizer plots.

And Mike Volek, station superintendent, got a few days this summer to



Behind the present "showplace" appearance of the Highmore station is the very same mission that prompted its beginnings on the arid, windblown prairie: development of the drought-resisting crops so desperately needed in the area.

spruce up headquarters and put an overhead door on the shop.

"It's been hard to open the doors to get to the snow equipment in the winter," he said.

Not to worry about these aberrations in the research, said Arvid Boe, forage researcher and interim manager of the station. "We have to think of our neighbors, too. They don't mind the extra moisture.

"We simply recorded what happened and put all that in our data banks. We're in this for the long haul, another

100 years at least, just like the families out here."

Research at Highmore continues to focus on the mission established when the Frank Drews donated the land in 1899. Their stipulation was that the farm be used as a research station to determine "drought resisting forage crops."

The focus now includes small grains, row crops, and alternative crops, along with improved farming practices suited



Vance Owens explains at the Highmore field day that either berseem clover or peas, planted with the oats behind him, will increase crude protein in the forage.

to the stressful environment of central South Dakota.

Boe has an experimental yellow-flowered alfalfa that he thinks is well suited for dry areas where one cut per season is the norm. The alfalfa won't stunt or drop leaves if attacked by potato leafhoppers. But his problem is that he can't get enough seed together to make the variety commercially usable.

"It never has a peak flush of flowers. Conventional alfalfas flower for 2 or 3 weeks, then set seed. Yellow-flowered alfalfas just keep putting out new stems and branches while blooming.

"So if we clip before it flowers, maybe we can set it back. It has a biological clock and it wants to get in flowering before the days shorten. Clipping might force more plants to flower at the same time, giving better seed production."

Boe works with Robin Bortnem, Plant Science Department, on this project.

He and Volek plan to put in a switchgrass project next year with Department of Energy (DOE) funding. Switchgrass has been evaluated in southern states as a possible green alternative to fossil fuel.

Converted into ethanol it appears to have a better energy output/input ratio than corn. Or if it is burned with coal, the mix produces a higher heat rate than

the coal alone and significantly reduces emission of several coal pollutants.

In the field, "switchgrass produces high yields, but if it's going to be anywhere near economical, it will have to be grown on land that won't support profitable production of higher-value crops. DOE is predicting switchgrass at 2 to 3 tons per acre here could be worth up to \$50 per ton as feedstock for biofuels."

Providing, he added, it has a market.

South Dakota researchers will be testing DOE-chosen varieties of switchgrass at Highmore for drought resistance.

"I really suspect that our own varieties, 'Sunburst' and 'Summer,' will be superior to those selected for yield and brought in from farther south. I'm very interested in seeing how ours measure up."

Owens spends most of his Highmore time on forages.

"Highmore must have a long history of good forage research," said the relative newcomer to SDSU, "because the people in the area are always willing to come, to listen, and to take new ideas home with them."

He concentrates on annual forages to use as emergency crops.

"If a producer had to do a late planting and still wanted pretty good hay and pretty good yield, I'd suggest one of the annual warm-season grasses such as pearl millet and foxtail millet. Normally, they show up better than they did at Highmore this year. We got more rain than they needed."

Or if, in the spring, the farmer didn't want to commit to a perennial like alfalfa or brome grass, Owens would offer peas or oats.

"You could grow either one for forage, harvest it, get good yields, get good protein, and be done in one year. You can plant early in the season, harvest, and still have enough time to plant something else, such as millet. That's doubling up on the forages in one year."

Owens also works with Bortnem.

Rudd is SDSU spring wheat breeder and fills in as winter wheat breeder. Since he came in 1992, Highmore has been one of the test sites for five new spring wheats released to the public. Beginning with 'Russ' in 1995 and through 'Oxen' in 1996, 'Forge' in 1997, 'Ingot' in 1998, and 'Ember' in 1999, scab tolerance has increased with each line. Test weight is good to very high.

"At present, Russ is grown on 25% of spring wheat acres in South Dakota, and Oxen has another 25%. The others just haven't had time to catch up and spread out yet," Rudd said.

Along with other sites in South Dakota and nearby states, the Highmore station also provides a testing ground for new winter wheat lines. Each year, 800 to 1,000 new experimental lines are developed by the winter wheat breeding program, Rudd noted. The best make it to Highmore and into the Northern Regional Testing Program for continued testing.

"Nekota' now has close to 25% of the acres in South Dakota," Rudd said. But 'Crimson' and 'Tandem' are gaining.

"Highmore is essential to our testing programs," he said. "It provides another environment, normally a little warmer, a little drier. Most of the time it provides enough stress to separate out different lines."

Rudd works with Brad Farber, Ravindra Devkota, Steve Kalsbeck, Rich Little, and Bob Hall in the wheat programs.

Despite the increasing popularity of soybeans in the Highmore area, no varietal testing is conducted at the station. That work has moved to the Dakota Lakes Research Farm south of Pierre.

Soybeans, however, are planted in a soybean-wheat rotation run by Jim Gerwing, SDSU soil scientist.

"My patch is as much a demonstration plot as it is a research plot," Gerwing said. "We know that if nutrients in the soil are already high, you won't get



Scab tolerance in spring wheats grown on test at Highmore has increased with each new line released. Experimental winter wheats are also planted at the station, which "provides enough stress to separate out different lines," according to Jackie Rudd.

enough increased yield to cover the cost of added fertilizer. But 'seeing is believing,' and that's one reason we're running these plots for farmers who tour the station."

Soil test levels before fertilizers were added showed phosphorus in the high range and potassium very high. Zinc is not usually an issue for soybeans or wheat. These nutrients are added in various combinations along with nitrogen. "We put them on every year, regardless of what the soil test says and then compare yields and soil tests with unfertilized plots.

"As expected, there was no yield response."

As the years go by and the evidence mounts up, Gerwing says soil scientists can become even more confident that the original soil test levels "were perfectly adequate" for expected yield goals. "When farmers see the crops and compare the yields, they will have convincing proof of the value of soil tests."

Gerwing also measures year-to-year variability induced by weather and rainfall.

"You don't just get different yields with different weather. You also get different rooting patterns when the ground contains different moisture levels. The

plants change their ability to take nutrients out of the soil, depending on when precipitation comes and where the roots are."

Gerwing works with Ron Gelderman, Anthony Bly, and Volek at Highmore. There are similar sites at other research stations.

Farm-program flexibility has changed how farmers view weed control, Leon Wrage said. Traditionally, farmers in the area have used a wheat-fallow system.

"But now, because they can branch out to other crops, herbicide carryover becomes a critical issue. Now the choice of chemicals to use on the wheat must be based on what the rotating crop will be."

When wheat was the only crop in the rotation, cheatgrass moved in and became an "extremely unmanageable problem," said Wrage.

"Cheatgrass has the same life cycle as winter wheat and its seeds ripen slightly ahead of the wheat. It has an advantage over wheat any way we cut it."

There is relief in sight.

"One of the experimental herbicides we have been evaluating at Highmore has received EPA registration and is

available this fall. We have had at least 4 years of experience with timing of application and rates, so now we can fine-tune our recommendations for the use of Maverick."

Wrage relies on filler crops.

"We have plots on half or less of the area assigned to us, because where you had a plot one year, it has to 'rest' for one or 2 years to make the weed pressure uniform again and to get away from carryover effect.

"We use all natural weeds at this station. We work with what nature gives us.

"Weeds are very visual." That's why he welcomes visitors and warns them that he is using a numbering system to evaluate herbicide responses. It's not based on counting weeds.

"If I say this plot is a '95,' I don't mean that only 5 weeds are left out of 100. I mean it's pretty clean. When a plot is below 70 or 75, we aren't satisfied with the weed control. Assigning the numbers turns out to be a balance between art and science, and the farmers catch on fast."

In recent years, weed work has expanded to no-till corn, soybean systems, and no-till sunflowers. "This is the only station where we have for a number of years evaluated herbicides for safflower, an alternative oilseed crop."

Members of the weed team for this work are Darrell Deneke, David Vos, and Scot Wagner. ♦

Oats research, run by Dale Reeves and Lon Hall, and fungicide work by Marty Draper, M. Thompson, Wrage, Vos, and Wagner are other current projects at Highmore, along with evaluation of the farmstead windbreaks and tree cultivars by the USDA Plant Materials Center out of Bismarck, N.D., and an oak tree study by Pete Schaefer of the Horticulture, Forestry, Landscape and Parks Department.

Biostress challenge:
*drought-ready varieties for
 Hyde County, mid-South
 Dakota, northern Great Plains*



*SDSU scientists help analyze flooding
in Waubay Lakes chain*

Water, water everywhere

by Jerry Leslie

The decade of the 1990s was a wet one for northeast South Dakota, filling up streams, sloughs and lakes, flooding lake cabins, homes, and farmland, and washing out roads and highways.

One of the areas hardest hit was in and around the Waubay Lakes chain between Webster and Sisseton, a hollow in the earth's surface described as a closed basin.

In the last decade, the surface area of water in Day County alone quadrupled from 4 to 15% of county territory, and lakes rose 9 feet or more and show no signs of dropping as the century prepares to turn over.

A federal disaster declaration was made for seven counties in this region, and all federal agencies combined have spent around \$75 million since

1992, according to Rick Weiland, Region III director of the Federal Emergency Management Agency (FEMA).

Nobody in the locality remembers anything like this. Weather records don't go back much beyond 100 years. People have a lot of questions.

Will the lakes go down, and how soon? Will they go even higher? Should the U.S. Army Corps of Engineers build dikes or should they pump or drain the basin? How high should new road beds be built? Should homeowners be required to have flood insurance? Will farmers ever get their land back or will they lose even more?

FEMA has commissioned a \$900,000 study of the basin. It is scheduled to give a history of lake levels going back perhaps as far as 3,000 years and give probabilities for repeat problems in the basin.

Four faculty members of SDSU, plus several SDSU alumni now working in allied government agencies, are making important contributions to this inter-agency, multidisciplinary study.

SDSU investigators include Carter Johnson, professor of ecology in the Department of Horticulture, Forestry, Landscape and Parks; Al Bender, state climatologist in the Department of Ag and Biosystems Engineering; Pat Emmons, assistant professor in Civil Engineering, and Vernon Schaefer, director of the Northern Great Plains Water Resources Center in the Civil Engineering Department.

Project coordinator is Rick Benson, a civil engineer with the regional U.S. Geological Survey (USGS) Office in Huron. He is an SDSU graduate along with many other engineers working on the project from USGS, EROS Data Center, and the U.S. Army Corps of Engineers.

Johnson and his associates examined tree rings, hoping to document climate swings that pre-date written weather records. On an island in Waubay Lake, they found and cored living bur oaks dating back to 1839. By overlapping the Waubay tree cores with cores taken in 1992 from timbers, which were cut about 1864 at nearby Fort Sisseton, they could extend their records back to 1675.

Johnson also is coordinating additional paleoecology and climate research by dating old shorelines above current water levels and coring the lake bottom. The organic material which accumulates in the lake sediments, the invertebrates and pollen, can be analyzed to determine the frequency of wet periods over the past several thousand years.

Cabin owners along Waubay Lake wait for the results of a FEMA study, which may tell them if they can expect a repeat performance of flooding of these proportions. (Photo courtesy of Tom Harrington, Waubay.)



Tree rings are an excellent record of weather cycles. Carter Johnson overlaps cores from living trees with timbers in Fort Sisseton to stretch data on wet/dry cycles back to 1675. More dates mean better predictions of flooding recurrences.

“Although this project is dealing with flooding, the tree rings are probably even better at recording drought occurrences. That’s very important to agriculture,” Johnson said.

Bender, working with climatological records, developed the atmospheric portion of the study. He has provided most of the inputs for hydrological computer models that simulate effects of various weather scenarios on the basin.

Emmons worked on background information, the geology and hydrology of the closed basin, and compiled the history of current inundation through 1998. He also cooperated with USGS in Huron in interpreting the results of climate scenarios and computer modeling reports.

Schaefer coordinated the research of the other three faculty members for the USGS which had contracted to conduct the overall study for FEMA.

The agencies and entities involved besides SDSU include FEMA, USGS Water Resources Division of Huron, the South Dakota Geological Survey and Department of Environment and Natural Resources, the U.S. Army Corps of Engineers of Omaha, Natural

Resource Conservation Service, and the USGS/EROS Data Center.

The Northeast South Dakota Flood Study embraces an area of 406 square miles and takes in the following lakes: Pickerel, North Waubay, Enemy Swim, Hillebrands, Spring, Blue Dog, Swan Pond, South Waubay, Minnewasta, Rush, and Bitter, plus their adjacent basins and tributaries. The study area reaches out beyond Day County into parts of adjacent counties of Marshall, Roberts, Grant, and Codington.

Not all residents will like what this research has revealed.

The critical role of evaporation in the Waubay Lakes basin, for example.

Bender believes the area will need a long string of dry years, perhaps 8 or 10 years, with low rainfall, low humidity, high temperatures, and dry winds—translating to high evaporation—to take lake levels back down to 1980s levels.

Even 1976, the driest year on record at Webster, evaporated only 3 to 3.5 feet of precipitation, Bender observed. Waubay Lake has 9 feet or more to dispose of to get back to familiar levels.

A drought of the scope that would provide the combined precipitation deficit and evaporation needed to correct the current Waubay Lake situation hasn't happened in the last 100 years, Bender said. Should such a drought occur, several additional years would have to pass before the lakes dropped because of the storage capacity of the basin, Bender said.

This makes it reasonable to assume lake levels in the Waubay Lake basin will remain high for years to come, with the potential of lake levels rising even higher, he said.

To get where it is today, northeast South Dakota in the 1990s experienced "a double whammy," in Bender's words. "They not only got more precipitation, but also less evaporation. In these closed basins, the only way for water to leave is through an evaporative process," Bender said.

The Webster station received 6.6 inches above average annual precipitation in 1991-1998, but evaporation at that location averaged 4.4 inches below normal. The result was 10 or 11 inches more water each year at the surface that had to go somewhere, said Bender. So the basin filled up.

Bender added that once water saturated the many storage areas of the basin, including the soil profile, underground reservoirs, sloughs, temporary sloughs, potholes, and streams, it didn't take much of a rain to run off and raise lake levels.

Wet and dry cycles come and go. A fluctuation of 10 feet in lake level would be the range of variability within normal expectation based on observations during the past 100 years, Bender said.

Weather records show the Webster station has had four wet periods: 1899 to 1916 with an accumulated departure of 25.72 inches; 1937 to 1948, departure of 20.56 inches; 1960 to 1966, departure of 22.48 inches; and 1984 to 1998, departure of 48.75 inches. Typically, dry spells of about 10 years returned lake levels to "normal."

The current wet spell began in 1984, and would have been expected to end in the mid 1990s, Bender said. But instead, heavy precipitation continued into 1999 in a basin already saturated.

"The threshold of vulnerability for this system appears to be about an accumulation precipitation departure of 22 inches in 10 years. The wet period beginning in 1984 caused Waubay Lake to rise about 9 feet by 1994."

Some commentary about climate change is expected to be in the report. An internet EPA page shows a band of rising precipitation this century that includes all of South Dakota and extends east across the Great Lakes to New England. The EPA reported gradual increases in precipitation of 10 to 20% over the central and northern Plains states since the 1920s, much of that in the last few decades.

Johnson reported that the tree cores his group gathered correspond well with weather records and dates for high water and low water periods.

"Since tree rings seem to represent the climate well in the modern period, that is a very good sign that we could use rings when we don't have any actual weather data.

An attempt was made this summer to carbon date the old lake shore that is higher than the current lake shore. "That will tell the long-term frequencies of these kinds of extreme events. You interpret things differently if you find that shoreline was 300 years old versus 3,000 years old. The chance of a recurrence would be more worrisome if you knew it was 300 rather than 3,000 years old."

The University of Minnesota was subcontracted to analyze and date lake bottom sediment cores, Johnson said. The clam shrimp, an invertebrate that lives in lakes, develops a shell that gives clues. Analysis of the calcium-to-magnesium ratio of shells at various depths in the sediment will reveal the salinity

of the water when the organism lived. The more brackish the water, the shallower the lake. Salinity of the lake now, of course, is very low because of dilution from recent rainfall.

"Probing history from three different directions will strengthen the results. There will be no question about the results if we get the same message from all three analyses," Johnson said.

Project Coordinator Benson said the completed study will tell people if "what they are experiencing today is a 5,000-, a 500-, or a 100-year event."

The study has regional implications, said Benson. "What we learn will have transferability," especially to Devils Lake, N.D., and to the Lake Thompson-Whitewood chain near Lake Preston and DeSmet, both of which are closed basins. One of the many possibilities considered, which likely will be discounted, Benson said, is a basin rising another 15 or 20 feet at which point it would spill into the Big Sioux River.

Benson concluded by saying the scientific expertise of SDSU scientists—paleoecologists, climatologists, and civil engineers—"was invaluable to us. The interagency, multidisciplinary cooperation has been very good."

A judge's ruling in July directed the removal of two berms between Waubay and Bitter lakes, allowing water to flow into Bitter Lake. This change in water flow sent engineers back to the drawing boards to update their models and revise calculations used in scenario outcomes. The updated report should be released in late 1999. ❖


Biostress challenge:

cooperative research to lessen the impacts from natural disasters

Making milk better

Higher fatty acid content contributes to healthier dairy products

by Jaimi Lammers



Milk does a body good—in more ways than one. We all know that milk is a good source of calcium. Now, scientists at SDSU are saying that if the proportion of unsaturated fatty acids in milk is increased, our risk of heart disease and cancer could go down.

David Schingoethe, SDSU dairy scientist, wants to improve the nutritional value of milk, making it a healthier product for human consumption. The direct impact on dairy producers is a higher demand for specialized milk and other dairy products.

"The overall objective is to sell more milk. We can point out the already well-known nutritional advantages of milk, but research like this looks at how to improve the quality of milk even more," said Schingoethe.

Using this technology from SDSU, dairy producers can create niche markets for themselves. "If a dairy processor says, 'I want to produce dairy products that are high in some of these healthful fatty acids,' then they may contract with producers in a certain area," he said.

Anticarcinogenic fatty acids were found to naturally occur in beef and dairy products by Wisconsin scientists in the 1980s. Named conjugated linoleic acids (CLA), this group of fatty acids exists in several forms, but the most biologically active form of CLA in preventing cancer is the *cis-9, trans-11* isomer, said Schingoethe. Coincidentally, this happens to be the form present in the greatest abundance in ruminant products, he said.

The rumen, the cow's first stomach, is basically a large fermentation vat brimming with bacteria, fungi, and protozoa. Unsaturated fatty acids are toxic to those organisms, so several of the organisms tack hydrogens onto those fatty acids to neutralize their toxicity, explained Schingoethe. *Cis-9* and *trans-11* are organic chemistry terms that refer to the shape of the specific docking devices that lock hydrogen molecule and fatty acid chain together.

In ruminants and, more specifically, in cow's milk, 80 to 90% of the CLA will be in the *cis-9, trans-11* form. But if made

synthetically, only 35 to 40% of the CLA will be structured in this manner.

"You can go to some health food stores and buy CLA, but it's probably made in a chemistry lab and you need three times as much to get the same health benefits as the CLA made by the dairy cow," he remarked.

Recent research results indicate that feeding CLA to laboratory animals may help reduce obesity, possibly by decreasing deposition of body fat and increasing the utilization of fat by the body.

"People get all excited about this because the typical American likes to eat excessively but stay thin," Schingoethe said.

Just as valuable in the long run, he added, might be learning the mechanism by which CLA reduces the odds of cancer. "With cancer, we get uncontrolled growth of cells. CLA might be a kind of metabolic brake on this growth."

Transvaccenic acid (TVA), an 18-carbon fatty acid with one unsaturated bond on the eleventh position as *trans* (*trans-11* C8:1), is another healthful fatty acid found in ruminant milk and meat. Laboratory animal studies have shown that TVA inhibits colon cancer and decreases fat accumulation.

"Just this past year, scientists reported that humans and other mammals can convert TVA to CLA. That helps to explain the role of TVA in the prevention of cancer and obesity," Schingoethe said.

In fact, TVA may be more effective, ultimately, in elevating CLA content in the human body than direct consumption of the CLA itself. "We can get a similar boost in TVA content of cow's milk as we get in CLA with the same amount of feed, and the TVA is already present in larger quantities," Schingoethe said.

Milk from cows fed stored feeds such as hay, silage, grains, and protein

supplements typically contains 3 to 7 milligrams of CLA per gram of fat. The same milk contains 10 to 12 milligrams of TVA per gram of fat.

The *trans* fatty acids formed during the hydrogenation of vegetable fats food products such as margarine are different from the three *trans* fatty acids, the TVA, found in cow's milk, he added.

Omega-3 fatty acids are the third group of healthful fatty acids found in milk. Evidence shows omega-3 fatty acids may increase immunity against some diseases, said Schingoethe.

"In the 1970s, Eskimos, who consume a large amount of fish and who consequently also consume a large amount of fish fat, were found to have a lower incidence of heart disease," explained Schingoethe. "Through the years, researchers have found that eating fish offers some protection against heart disease."

Cold-water fish are the main source of omega-3 fatty acids. By including fish oil in the bovine diet, the researchers hope to increase the omega-3 fatty acid concentration in milk, with the end result that consumers, and possibly cattle, would attain immunity from cardiovascular disease, rheumatoid arthritis, dermatitis, and ulcerative colitis.

"You might say we're converting an unpalatable fish oil into a palatable cheese, butter, or ice cream," Schingoethe remarked.

Scientists "have to keep their eyes open for the unexpected," Schingoethe said. Experimentation can often shoot off in unplanned directions. When Schingoethe began this work, his only intent was to increase the unsaturated omega-3 fatty acids. "We weren't even thinking of CLAs or TVAs. Lo and behold, that's where we got the big increases."

Schingoethe looked at several different sources to increase the proportion of unsaturated fat in the cow's diet.

Most grains and forages are only 2 to 4% fat, so other sources had to be considered to raise the dietary fat content, he explained.

The research group ended up feeding whole soybeans that were 18 to 20% unsaturated fat and sunflower seeds that were more than 40% unsaturated fat.

But that was only the start.

"Feeding the soybeans and sunflowers, at most, doubled the CLA content, but when we went to the marine products, on the average, we got a five-fold increase.

"Ironically, those products contain almost no linoleic or linolenic acid, polyunsaturated 18-carbon fatty acids. They're predominately 20- and 22-carbon length fatty acids; fatty acids the bacteria and protozoa in the cow's rumen don't efficiently metabolize," he said.

The large increase may be attributed to a couple of circumstances. Rumen organisms may form some of the CLA and TVA from those long-chain fatty acids, commented Schingoethe.

It may also be something that has a catalytic effect. "Some of those fatty acids from fish oil may stimulate the rumen organisms to form CLA from the fatty acids they're getting from the alfalfa hay, corn, and corn silage," he suggested.

Two marine products, algae and fish oil, were fed. The algae mix is more of an experimental product, mainly available to researchers. Fish oil, a byproduct of the fish industry, is readily available. Producers are already feeding it in some parts of the world, Schingoethe noted.

The marine products were incorporated into a total mixed ration. "Mixing the silage, hay, and grain with the fish oil is far more effective than just pouring some on top of the feed," he said.

Other experiments are designed to find how much fish oil to feed and the best way to feed it to achieve the most benefit.

"Can we get that same boost with a smaller amount of fish oil and let the rest of the fat come from, for instance, soybeans?" he said. "You do an experiment to answer one question and you ask 10 others."

In a related trial, Bob Baer, dairy manufacturing professor at SDSU, is looking at milk flavor. "They are evaluating butter from the experimental milk," reported Schingoethe.

He would like to market the milk through cheese, ice cream, or butter. Only about 35% of all dairy products are consumed as fluid milk. Schingoethe predicts, as time goes on, less and less milk will be consumed as whole milk; more will be consumed as reduced fat and skim milk, and as other dairy products, such as cheese.

"If there's something that will improve my health that is concentrated in the milk fat but I'm drinking 2% or skim milk, I'm not going to consume much of that 'something,'" he said. "But if I can get the needed CLA, TVA, and omega-3 fatty acids while eating normal amounts of cheese, ice cream, or butter made from milk that contains naturally enhanced amounts of these healthful fatty acids, then I'll meet my nutritional needs.

"This research is on the right track, and who knows what else we may discover in the process of working on these unsaturated fatty acids." ❖



David Schingoethe, left, and Bob Baer, examine experimental milk packed with "good" fatty acids.

Biostress challenge:
*expanding the nutrition
and marketability of
dairy products*

Students trade in commodity futures

No 'phony money' or 'playing' the markets. This is serious business, the best kind of hands-on learning

by Jaimi Lammers

Students are trading agricultural commodity futures and options at SDSU. The Economics Department offers AGEC 493, Special topics: trading in commodity futures, to upper-level undergraduate students interested in hands-on learning about agricultural commodity markets.

"I think everyone should take this class if they are going to pursue a job in the livestock industry," said Kimball native Jesse Larsen.

Larsen took the class during the 1998 fall semester. He graduated in May 1999 with a bachelor's degree in animal science. "Learning to use the stochastics and the volume and open interest combination will be good for me since I will be working at home on a feedlot," he said.

Bashir A. Qasmi, assistant professor of economics at SDSU, stressed that students "run" the class. He believes the instructor's proper role is to provide the structure that facilitates learning through individual and group research.

There is no time for Qasmi to "lecture," even if he wanted to. Class time is taken up by group discussion and decisions.

Nor are there formal exams or tests. Students are graded on class participation and the one-page market analyses

they submit at each meeting. An analysis explains the student's marketing proposal, tying in all available and relevant information relating to the commodity and using fundamental and technical price analysis to explain the short-run and long-run forecast for the commodity. The paper also spells out the exact wording of the proposed order, if any, and any contingencies. That requires students to have better than a merely superficial understanding of basic marketing and economic fundamentals, said Qasmi.

"Two people can look at the same chart and see two totally different things," commented fall 1998 class member Ben LeBrun, Flandreau. "Some people see the importance of fundamental and technical analysis different-

ly. I think you need a mix to have your best chance of correctly predicting what the market will do."

"Even though all of the technical and fundamental indicators can point one way, the market can easily go the other way," agreed Marty Michalek, Chamberlain native. "Speculating in commodities is just as risky as any other form of gambling."

Michalek graduated in December of 1998 with an ag economics degree and now works as an ag loan officer for Farm Credit Services of America.

Students can only learn trading by doing actual trading, said Qasmi. "Trading knowledge and, better yet, trading



Clay Roll, left, a commodity broker in Sioux Falls, places the order of Bashir Qasmi's commodity trading class. When it's their money on the line, students will learn the markets better and faster, Qasmi commented. Roll took the class several years ago.

experience is of great value in developing and implementing a marketing plan," said Qasmi. "The hands-on experience gained in this class allows the producer to implement appropriate hedging strategies free of additional anxiety."

Students use their own money for trading. Although not required, each of the 14 students in last fall's class as well as the instructor contributed \$300 to form the "Super Ag Commodities Investment Club"—a commodity trading partnership pool.

Each member equally shares the profits as well as the losses from all trades, and has one vote on all decisions related to any trade, said Qasmi.

A number of other universities offer similar classes, but only a few have students invest their own money, said Qasmi.

"I strongly believe that the best way to learn how to trade commodities is by actually trading with real money, so that each trade decision has financial consequences," said Qasmi. "It matters when it's your money. Most people tend to trade recklessly with phony money."

The intensity with which the students followed the market supported Qasmi's plan. "Investing my own money in the club forced me to pay attention to what was going on and made the class very realistic," said Michalek.

For the previous 2 years, the commodity investment club generated a nice profit. However, the club lost money during the fall 1998 class, the first group in the 3-year history of the class to lose money.

"I was a little bit concerned about students losing money in trading, but they do understand that this is the cost of learning. It is still the cheapest way to learn futures trading," said Qasmi.

"If the saying 'you learn from your mistakes' is true, we should be the smartest commodity investors in the world," commented Michalek. "Even

though the experience ended with a financial loss, I would consider the class a success from the aspect of an educational tool."

"Successful trading depends on one's ability to forecast the market, place the correct orders, and manage market risk," Qasmi said.

"Students will know more about the markets if they've tracked them closely for a few months than a Ph.D. in ag marketing who hasn't followed the markets for some time."

However, students in the class weren't quite as confident in themselves. "Before this class, words like trendlines, support and resistance points, retracements, open interest, and volume contained little meaning for me. After this class, I at least know the general uses of these tools," said Michalek.

And some students learn that trading's not for them. That is also a positive learning experience.

"I found that speculating is much tougher than a person would think and that it's not something I want to do," added LeBrun. "As a producer, using futures and options to lock in prices and using them as protection is the route for me.

"Getting the hands-on experience and actually buying and selling contracts and using the correct terminology as well as understanding the unspoken rules were valuable lessons to learn," said LeBrun.

The students divided into six groups, each focusing on a different commodity and meeting two or three times a week. At every meeting, students from each group presented an analysis of the market and a proposal of action for their commodity. Depending on what they learned from their fellow students, club members voted on the course of action for each commodity.

The orders were then communicated by the club secretary to Clay Roll, Com-

modity Services, Inc., in Sioux Falls and a 1996 SDSU graduate in animal science. The open positions were then evaluated in the next session.

Incidentally, Roll took the class the first time it was offered and has since joined the Sioux Falls business as a commodity broker and agricultural hedging consultant, reported Qasmi.

Commodities traded during the fall 1998 semester were corn, soybeans, wheat, live cattle, hogs, and feeder cattle.

"Sometimes the tension got pretty high in the room when money was being lost. I think that it is pretty funny when a proposal has unanimous approval and then loses money and people are upset at the group that proposed it," remarked Troy Hadrick from Faulkton.

An indication, students and professor agreed, that commodity trading is more than making or losing money; it requires clear communications between people, a life skill the students will use in any career.

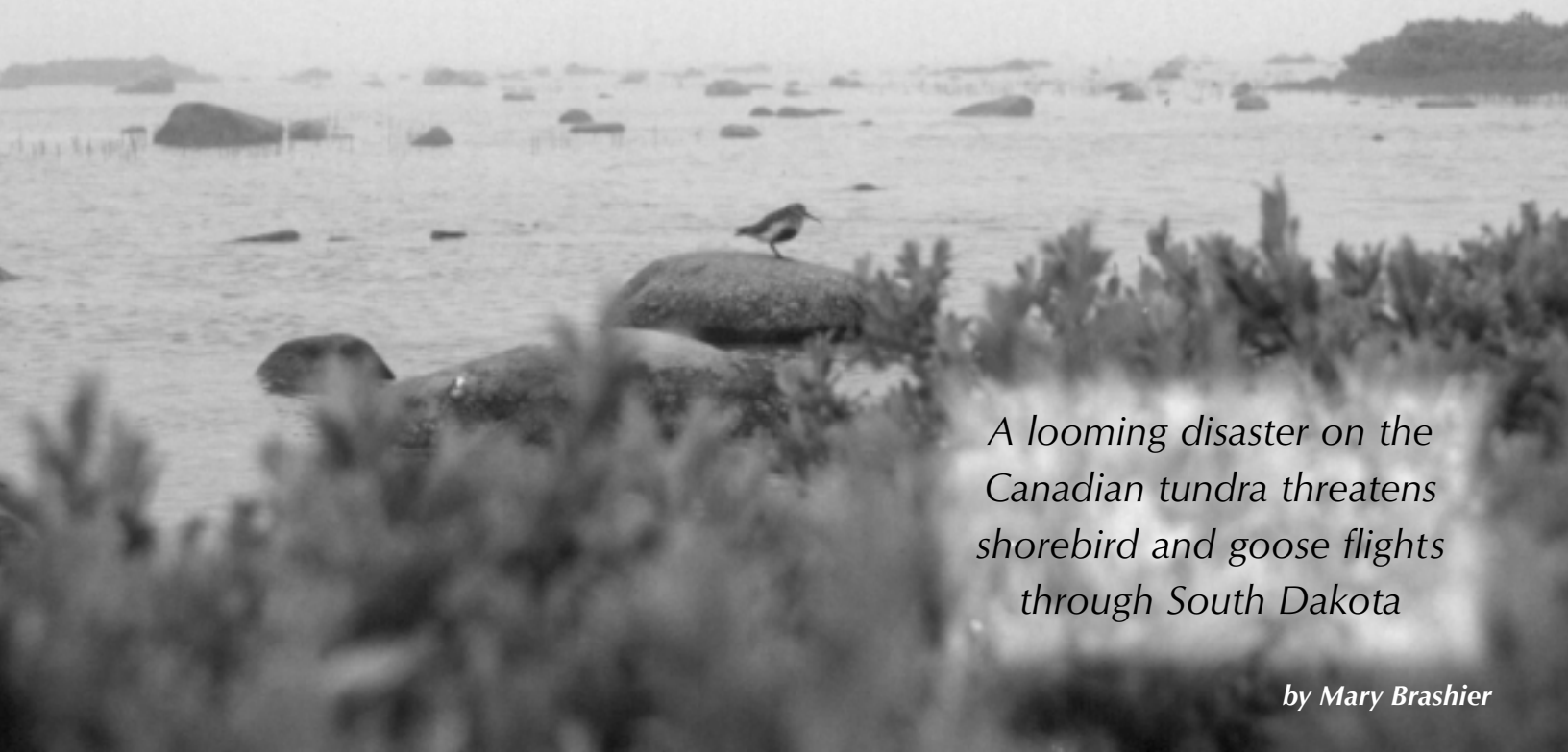
Qasmi said trading techniques are universal. "If you've got the basics down, you don't have to stick to ag markets," he stated.

And students certainly do learn the basics in this class. Wilmont native Robert Bohlke may sum it up the best: "This class is definitely a great educational tool to help a person understand the markets," he said. "I have received more of an education from this class than from any other marketing class I have taken. Many of the skills I acquired in this class will be used in the future market decisions I make." ♦

Biostress challenge:

*learning-by-risking in
the futures markets*

The South Dakota connection



A looming disaster on the Canadian tundra threatens shorebird and goose flights through South Dakota

by Mary Brashier



The dunlin, top, and the semipalmated plover, left, are only two nesting shorebird species at the mercy of the snow goose (bottom) along the Hudson Bay coastline.





Scientists barricaded themselves in fenced compounds at night. Bear sightings were higher in the 1999 summer, Les Flake said, because of the previous mild winter when ice formed late and broke up early on Hudson Bay. Bears, denied their normal take of seals, were hungry for geese.

Why was a scientist from SDSU walking the mudflats of the Hudson Bay coastline 1,100 miles from South Dakota?

Why was he looking for shorebirds and mostly ignoring the immense gatherings of snow geese adults and goslings all about him?

Why did he often stop work, stand up, and stare intently in all directions?

And what does all this have to do with South Dakota?

Portions of their northern nesting grounds have become “death traps” for snow geese, said Curtis Vacek, former graduate student in the SDSU Wildlife & Fisheries Department. In these areas, goslings are underweight and weak and may not reach flight status before freezeup.

“I went up there hoping to see some original tundra. But there’s no such thing as an intact habitat left. Everything’s been degraded by the geese.”

Vacek had to settle for “moderately” and “severely” damaged experimental areas for use in his thesis research at La Perouse Bay. Geese are destroying the tundra, literally “eating themselves out of house and home.”

Vacek wanted to see if this destruction of the habitat, caused simply by

too many geese in one spot, was also destroying the food supply of shorebirds and wrecking their nesting and feeding habitats.

If that turned out to be the case, the swelling populations of geese could be a major reason for the decline in some shorebird populations that has been noted across the North American continent.

This establishes the South Dakota connection, said Les Flake, Vacek’s thesis advisor in the SDSU Wildlife & Fisheries Department.

“When we see an overall decline in shorebirds that have been abundant up to this point, it is a signal that their habitat is in peril.”

The opposite signal, the soaring numbers of “light” (snows, blues, and Ross’) geese, also indicates “things are not going right,” Flake said. “We have let things get out of balance in the eastern and central Arctic coastal areas.

“This is bigger than just the geese,” Flake said. “They’re the visible signals most of us see first. South Dakotans are observant enough to know that when a population increases drastically, it sets itself up to crash drastically. That would mean the loss of hunting opportunities—the sunrises, geese, dogs, and good companionship, and the loss of

continued on page 23



Geese and goslings can be herded when adults are molting and young are not yet flying. Their own health is suffering as ever more birds crowd into a deteriorating habitat.

Light goose spring season is a start in regaining balance

The 1998 fall migration of midcontinent light (snow, blue, Ross') geese was conservatively estimated somewhere around 6 million birds.

"That's twice as many as there should be," said Spencer Vaa, South Dakota state waterfowl biologist for Game, Fish & Parks.

So when the birds came back north this spring, Vaa and hunters up and down the Central Flyway were waiting for them.

The spring hunt for light geese in the Central Flyway was the first in 80 years, and it took an amendment to an international treaty to pull it off. The Migratory Bird Treaty of 1918 banned hunting of migratory birds after March 10 each year.

The South Dakota season opened on February 18, and the birds showed up a week later. High densities were located in McCook, Lake, Kingsbury, Clark, Spink, and Brown counties. Sand Lake NWR hosted over a half million birds during mid to late March. The season lasted until April 30, and hunters could hunt till a half hour after sunset and use unplugged shotguns and electronic callers.

Hunters in South Dakota bagged over 62,000 light geese during this season. "That's about three times as many as during a normal fall hunt," Vaa said.

"We are the only state that had a limit (20 birds per day). We want people to use the birds they shoot."

When geese leave their nesting grounds in the fall, they're hungry, Vaa said. "They head for the first place they can find food, and that's in fields in southern Canada. With plenty to eat, they're in no hurry to move on south. Every year they come into the Dakotas later and later.

"Then, when we get our first November blizzard, they just blow on by. We might get in a week of shooting.

"This spring we had 5 weeks of hunting."

Wildlife biologists hope spring seasons, conducted for 3 to 5 years, will thin out the goose population. Light geese have overpopulated their nesting grounds, and a crisis is looming.

The geese are nesting in "slum" conditions, he said.

"Landsat photos of the west side of Hudson Bay show that the geese have done a number on 1,500 miles of the coastline. A third of the habitat is destroyed, another third is nearly gone, and the remaining third is damaged. One look at these pictures would convince anyone that the ecosystem is out of balance."

Mudflats and bare ground have replaced Arctic grasses and, given the fragile ecosystem, the plant life will never recover if steps aren't taken to reduce the population of geese, he added.

The reasons for the overabundance of snow geese illustrate how South Dakota grainfields and Canadian nesting



Grubbing and grazing of light geese create "slum conditions"; the birds must walk farther and farther inland for food, destroying even more of the fragile ecosystem. The increase in bare ground means less insect larvae and seeds for shorebirds, whose numbers are declining.

grounds are linked in a complex North American ecosystem.

"The birds simply eat their way up and down the Flyway. They are in fantastic breeding condition when they arrive up north. This wasn't always the case. Once, there were grasslands from Texas to Hudson Bay, but now there are cornfields for the birds to feast in. And when they get tired, they can rest in the state and federal refuges that weren't there in early days either."

Also contributing to the overabundance of geese is the decline in hunter harvest over the past 25 years. Measured against the midwinter population, harvest has declined from near 40% to under 8% annually.

But the 2000 spring season may be in jeopardy, Vaa said. Faced with the need to prepare an expanded environmental impact statement due to a lawsuit from an animal rights group, federal and state agencies may not be ready in time. There is also the wild card of possible Congressional action.

The spring season and the relaxed regulations are based on science, Vaa emphasized.

"They are the recommendations of a working group of 17 top scientists and waterfowl managers from across Canada and the U.S., and they represent government and private conservation organizations and universities. Their recommendations are based on solid, scientific data, not emotion.

"The most reasonable solution is based on science, and it says, "thin down the population before it crashes."

considerable income to private and public coffers from those foregone hunting trips.

“And shorebirds are a valuable part of the ecosystem. Many of us up and down the flyway take time out to watch them. We’d miss them. And they also have economic value.”

As long ago as 1911, scientists found shorebirds could play a valuable role in controlling disease-spreading mosquitoes and agricultural pests such as horseflies, grasshoppers, and army worms. This finding led to the inclusion of shorebirds in the 1918 Migratory Bird Treaty between the U.S., Canada, and Mexico. In it, hunting of shorebirds was prohibited and regulations, to be revised annually, were set on the hunting of waterfowl.

Despite liberal bag limits and long seasons, these regulations have still been too stiff when it comes to snow goose management. Conservative estimates count approximately six million light geese on Canada’s nesting grounds, and they have been expanding at an annual rate of 5% since the 1970s. The midcontinent lesser snow geese, the major species involved, has increased by more than 300% in the past 30 years.

As a consequence, many other animals in the eastern and central coastal

ecosystem, from caribou right down to snails and insect larvae, have taken severe hits. The fragile plant life may never recover in our lifetime. The Canadian North along the coast line is becoming “a salt desert” as a result of the grubbing and grazing of too many snow geese.

Polar bears don’t seem to notice that anything is wrong. They snack on weakened and healthy goslings alike.

And that’s why Vacek stopped work every once in a while and checked over his shoulder. His concern: Was any of these prowling predators planning to add variety to its goose diet?

The wetland complexes of the Hudson Bay lowlands provide “prime nesting, roosting, and foraging habitat for certain shorebirds,” Vacek said.

Part of these wetlands are the coastal salt marshes of the La Perouse Bay near Churchill, scene of “the most studied snow goose nesting colony in the world,” according to Ducks Unlimited. Scientists began studying birds on the site in 1968 when there were fewer than 2,000 pairs of geese to be counted. In 1997, an estimated 45,000 pairs packed the area.



Hudsonian godwits were too few to measure; they were seen only in less degraded habitat.

The shorebirds, on the other hand, were declining.

“Since 1968, the visiting scientists at the research station up there every night would compare their list of different bird sightings for that day. That’s been going on for 31 years and the list has been growing shorter and shorter,” Vacek said.

Nesting studies also had documented dramatic declines in shorebird species. Vacek wondered if this was because the insects on which they normally forage were not able to survive in the denuded habitat left behind by grazing geese.

With a healthy goose population, Vacek’s study area would have consisted of a lush mixture of grass and sedge swards interspersed with colonies of willows. But both his “moderately” and “severely” degraded areas were covered with a mosaic of mosses and bare ground, with the severely impacted site having half the cover of the other.

In his two study areas, he compared the abundance of shorebirds that would come to them to feed, plotted the food items they preferred, and then attempt-



Adults may be healthy; many young will die before migration, but not enough to alleviate overcrowding.

ed to link birds, diets, and invertebrates to the degraded environment.

Of the 23 species of shorebirds he sighted in two summers of work, 7 foraged often enough in his study sites to present Vacek with usable data.

As so frequently happens in science, his findings were mixed.

Dunlins, semipalmated and least sandpipers, and short-billed dowitchers preferred the moderately degraded habitat. Semipalmated plovers and pectoral sandpipers seemed to prefer the severe habitat. The white-rumped sandpiper would take its food where it could find it, in either location.

And all preferred large fly larvae, actively searching for this type of food. Smaller fly larvae, seeds, and snails were taken in lesser numbers, probably because the birds just stumbled across

them while probing for the large fly larvae, according to Vacek.

And there were more large fly larvae in the moderately disturbed habitat.

As to the exceptions, "I think the semipalmated plovers, although they seemed to be benefiting from the degradation by feeding more often on the mudflats, were actually looking for nesting habitat. Like killdeer, they prefer gravelly spots with minimal vegetation for nesting. It's possible that, if they are drawn to these bare sites to nest, they may have to spend more and more time foraging for less and less food and spend less time tending their nests and young. So survival of young may be very low.

"I don't have an explanation for those pectoral sandpipers. But even on the muddy flats, they too were choosing

the larger fly larvae over other food items."

Nesting studies document that species which prefer nesting in vegetative cover have decreased dramatically in numbers since the mid 1980s. Vacek's study tends to fit the pattern. It "certainly indicates that some shorebirds are in trouble up north on their breeding and staging grounds. Their preferred feeding areas are being destroyed by overabundant goose populations." ❖

Biostress challenge:

*working to restore
balance of species in
an international ecosystem*



The enclosure tells the story. Inside is a healthy plant community that on a large scale would support a balanced community of insects, snails, shorebirds, caribou, and geese. Outside, across the west side of Hudson Bay, are mudflats and bare ground.

Loaded for bear...

Hudson Bay polar bears go where the food is.

In wintertime, they walk the ice of Hudson Bay in search of seals. Before the ice is ready, they cruise the dumpgrounds and streets of Churchill. In spring and summer, it's the flats along the Hudson Bay where they find easy pickings among snow goose goslings.

"Bears add a different perspective to the landscape," said Les Flake, SDSU Department of Wildlife & Fisheries and Curt Vacek's faculty advisor. "All the time you're up there, you have the feeling you're not the dominant carnivore, that you could be lunch."

Flake was on the Canadian breeding grounds in summer 1998, participating in an international lesser snow goose project.

"At this stage of life, not many of them can fly. We herd them like cattle into a pen, check their health, and band them."

This may not go unnoticed.

"Once we had about 600 geese in a pen when we saw a bear crossing to the south of us. When the scent of those birds hit him, he immediately turned and came at us.

"They may look slow, but that lumbering walk is fast, and by the time he got within 200 yards, our helicopter pilot decided that was enough. He took off and chased the bear away. Polar bears are scared of the big bird."

Helicopters and tundra buggies with enormous tires are the only transports into the scientific stations. There are no roads in this area of Hudson Bay. The pilots have learned to not park their helicopters outside the compounds.

"When the bears catch the big bird asleep, they will trash it."

In the field, research parties carry cracker shells backed up

with slugs. A male polar bear may stand 9 to 10 feet tall and weigh over 1,200 pounds, Flake said. "If one charges you, you're not supposed to over react. It might be a false charge.

"But even a cub can kill you with one swipe. Sometimes they're more curious than hungry, but you don't take that chance."

At one field lab, when a bear came near the compound's electric fence, the standard cry was "Bear. Get on the roof." The scientists couldn't stop long enough to grab their cameras.

"One night, a big male charged a compound that had a 10-ft protective fence, hissing and ignoring the cracker shells exploding around him. He'd back up and charge again, three times before he gave up.

"If a bear did manage to break into a compound dorm building during the night, we had a drill. Everybody would role toward the wall except the guy on the end. He had the gun, and he was loaded for bear."

In over 25 years of work at these Arctic goose research facilities, no one has been injured by bears nor have any bears been hurt, Flake said. "Not to say there haven't been some exciting moments."



The trade-offs

Study finds acreage reductions may empty out Small Town, S.D.

by Larry Tennyson

We live in a world of trade-offs. Larger, more mechanized farming operations help provide more food but require fewer farmers. Chemicals can mean higher yields, sometimes at the expense of the environment.

Planting restrictions, set-asides, and paid diversions have been used in the U.S. since the 1930s, but in recent years, these programs have become increasingly controversial. If they lifted commodity supports and enhanced environmental quality, as advocates

claimed, were there unforeseen and unwelcome trade-offs?

This question prompted an investigation by Evert Van der Sluis of the SDSU Department of Economics and Willis Peterson from the University of Minnesota Applied Economics Department.

They narrowed their research to a workable level—the effects of these programs on rural economies. "In particular we asked: Did acreage reduction programs change the demand for the

services provided by the rural nonfarm population?" said Van der Sluis.

"Many goods and services used in agriculture are supplied by rural non-farm people, the people who supply the chemicals and who service and sell the machinery," he explained. "It's no secret that if rural South Dakota is prosperous, small-town South Dakota will be, also. There'll be new pickups bought at local dealerships, lumber for farmstead improvements sold, you name it, right down to more luxury items purchased on mainstreet."

The economic vitality and, more importantly, the population of rural towns and cities largely depend on the demands of crop and livestock producers for goods and services. If producers farm less land because some of it is in acreage reduction programs, their need for inputs—seeds, chemicals, etc.—will decrease. “Then what happens to the business owners they once purchased these inputs from?”

Van der Sluis and Peterson collected data from 100 randomly selected farming-dependent U.S. counties for the 30 years between 1960 and 1990. With a relatively high dependence on federal subsidies and few economic alternatives to agriculture, these counties were sensitive to any farm policy changes.

The study included all major federal acreage reduction programs in the time period, and the economists constructed various models to arrive at how changes in the number of cropland acres affected rural nonfarm population in the counties.

“The programs coincided with a reduction of rural nonfarm people in these 100 counties by 15 to 22%,” said Van der Sluis.

“So, although cropland diversion programs may have attained the primary goal of commodity supply reduction and environmental protection, these programs also may be responsible for losses in the economic well-being of rural communities.”

Van der Sluis cautioned that the conclusions are limited to 100 farm-dependent counties. Moreover, the economists did not examine the effects of lost tax revenues from land taken out of production, when either the tax burden on other enterprises must increase or services must be cut back.

And what is the impact of cropland diversion on people in counties with a broader mix of enterprises?



Economist Evert Van der Sluis says acreage reduction programs are good for the environment and help farm income but have negative impacts on small town jobs and businesses.

“Even if they have resources other than the agricultural sector, we still have no reason to doubt the direction of the impacts of cropland diversion programs is the same. They hurt some people. The overall impact is just not as severe.”

And, as county planners well know, it’s hard to attract new industries to rural areas.

“In the 30 years studied, we didn’t notice these counties becoming less dependent on the agricultural sector over time. If they had, the impact of the cropland diversion programs on the rural nonfarm population also would have diminished.

“So we can reliably say that although the cropland diversion program goals of supply reduction, land conservation, and creation of wildlife habitat may have been attained, the programs also seem to have contributed to the eco-

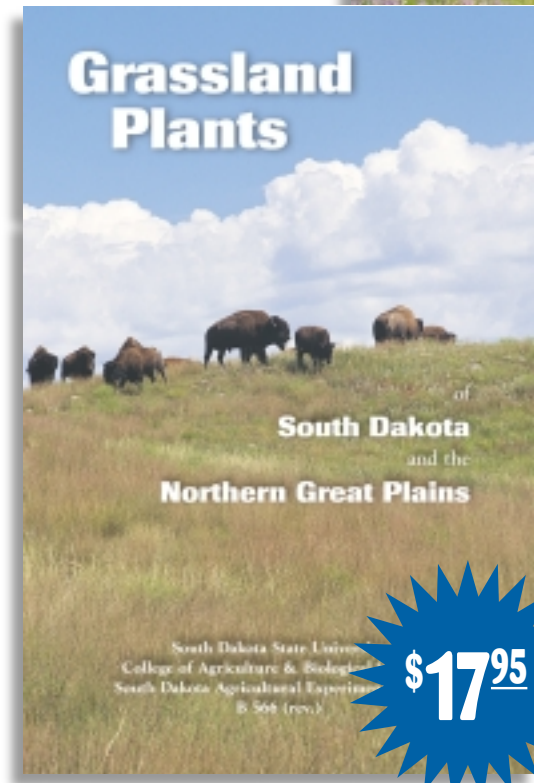
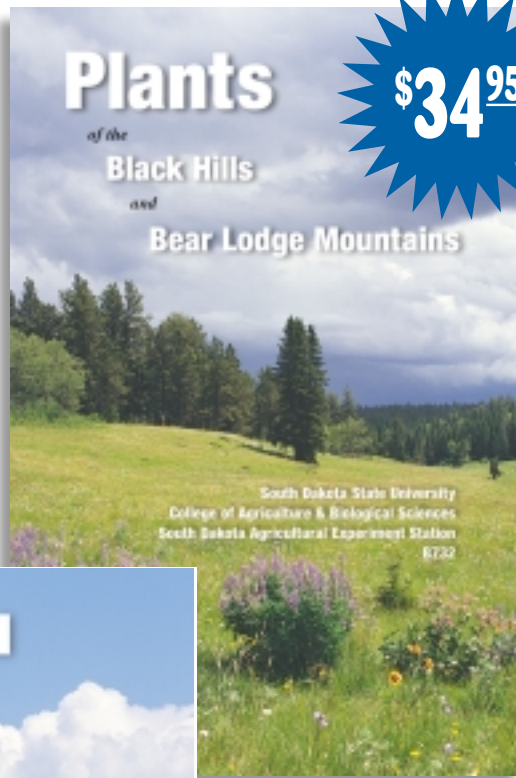
nomical and demographic decline of rural communities.”

All else equal, “perhaps the reduction in the number of diverted cropland acres prescribed by the latest farm bill will slow down the loss of the rural nonfarm population in farming-dependent counties,” Van der Sluis commented.

“So it’s a mixed bag with some complicated and far-reaching trade-offs. This isn’t a new perspective, but now we have the numbers to support what we’ve known intuitively.” ❖

Biostress challenge:
*balancing the benefits of
CRP with the trade-offs*

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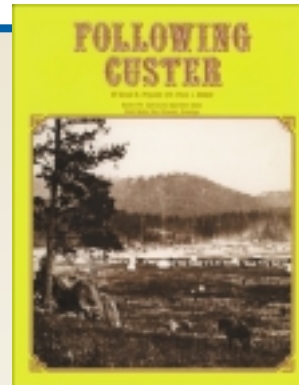
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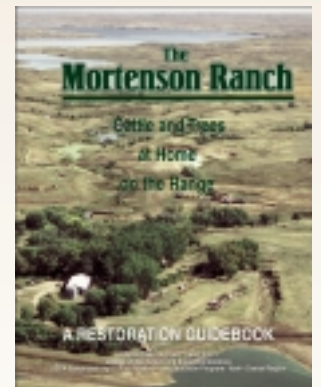
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