ARS, Companies Team Up To Boost Rural Economies

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Computer-controlled center pivot irrigation systems can be connected by modem to radios or telephones so farmers can run them remotely. (K4901-16)

When you're finished watering the garden, you walk out to the back yard and turn off the faucet. But John Chapman says it's not that easy for farmers who have sprinklers spread out across thousands of acres.

Chapman is director of research for Valmont Industries. Based in Valley, Nebraska, it is the world's biggest manufacturer of center pivot irrigation systems. A center pivot consists of horizontal pipes and sprinklers fed by underground wells or surface water. The pivot is anchored at one end and attached to wheels, allowing it to swing slowly in a giant circle, watering the crops beneath it.

It used to be that farmers had to jump in the pickup, drive to each center pivot, and tend it manually—a time-consuming job. But Valmont and U.S. Department of Agriculture scientists have developed computers and communications software that switch these remote sprinklers on and off automatically.

Chapman estimates that 30 to 40 percent of the center pivot irrigation systems Valmont sells have computers controlling them. Some of the systems are connected by modem to radios or telephones so farmers can run the sprinklers without even leaving their homes.

"As far as farmers are concerned, this technology has totally changed their lives," says Chapman. "Before, they'd have to get up in the middle of the night to turn something on or off. These systems will do that, and they also have automatic shut-offs if something goes wrong. The technology has totally changed the lives of the people who irrigate."

Developed by scientists with USDA's Agricultural Research Service, this technology is an example of how agency researchers have cooperated with private companies to solve agricultural problems [See chart on pp. 20-21.].

Cooperative work between private companies and ARS scientists has boosted rural development by helping farmers improve their efficiency, profits, and overall quality of life.

One farmer who says computerized irrigation has improved his operations is Richard Wenstrom. He operates 24 center pivots, each 1,280 feet long, on his 4,200-acre farm in south central Kansas. Using a computerized irrigation scheduling system, he applies the right amount of water to his crops whenever they need it.

"We think the computerized scheduling system has saved from $600 to $800 in fuel alone, each year, for each pivot we have," says Wenstrom, who grows corn, alfalfa, and soybeans.

The system, which Wenstrom started using in 1989, weighs climate data such as temperature, humidity, sunlight, wind, and rainfall, then determines when to turn the sprinklers on and off and how much water should be applied. Then he turns on the pumps by hand. "Now irrigation is an educated decision, not a random one," he says.

Wenstrom says the system has not only saved fuel, but has helped conserve valuable water drawn from underground aquifers. He estimates the system has saved 20 to 30 acre-feet of water for each pivot per year.

Since 1 acre-foot equals nearly 326,000 gallons of water, this means he's conserving from 6.5 million to nearly 10 million gallons of water with each pivot. Says Wenstrom, "Multiply that by 24 and you get some idea of the magnitude of water we're talking about."

He says there is a lot of interest in the system among farmers who want to cut their costs and conserve water—particularly in areas where aquifers could become depleted.

Wenstrom's interest in the computerized irrigation system goes back to his days in graduate school with Dale Heermann, an agricultural engineer now with ARS at Fort Collins, Colorado.

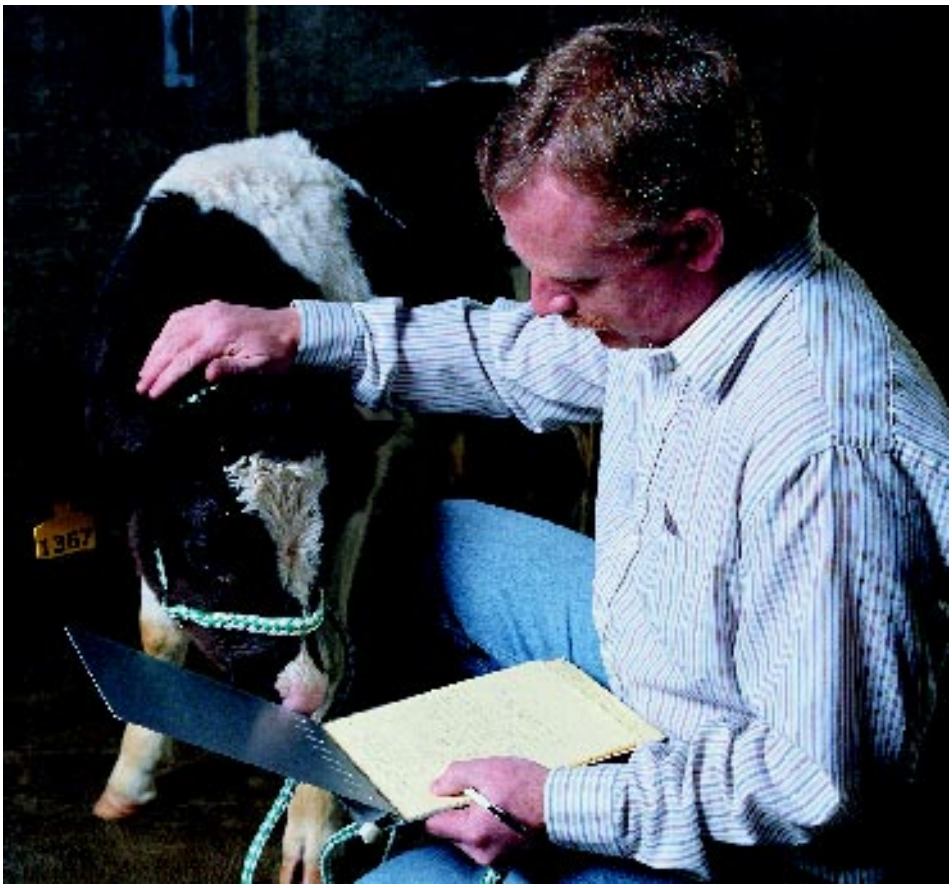
Heermann and colleagues have been working for 15 years on developing and improving computer irrigation systems. That research led to a formal cooperative research and development agreement (CRADA) with Valmont.

Laverne Stetson, who is with ARS in Lincoln, Nebraska, and Heermann have started a new CRADA with the Electric Power Research Institute in Palo Alto, California, to find ways to minimize sprinkler power demands during peak energy periods.

Heermann agrees with Wenstrom that computerized irrigation is catching on among farmers, estimating that 10 to 15 percent of all irrigated acreage in the United States is making use of at least some parts of the technology. That's from 5 to 7.5 million of the estimated 50 million irrigated acres in the country, he says.

"Any time farmers can save water it equates to dollars saved, and that helps the economies of rural areas," says Heermann. Overall, the technology has saved an estimated 160 billion gallons of water and 108 million kilowatt-hours of energy annually.

CHUCK GREINER



Veterinarian Marcus Kehrli records data on a dairy calf that has a genetic disorder called Bovine Leukocyte Adhesion Deficiency. Scientists hope to eliminate BLAD from dairy herds through research and DNA testing. (K7277-1)

BLAD Is Bad News

David Smokler has a herd of about 200 Holsteins on his dairy farm in Lancaster, Texas. Over the years, he and other Holstein dairy farmers have lost animals to various ailments that can be traced to a genetic disorder called BLAD.

That acronym stands for Bovine Leukocyte Adhesion Deficiency. Calves affected by the disease usually die within 7 months of birth because their white blood cells, known as leukocytes, become weakened and don't fight infection. As a genetic disease, BLAD cannot be spread to humans.

This disease hit cattle breeders particularly hard, because some of the most prolific Holstein bulls were found to have the recessive gene for BLAD, which could be transferred though semen.

Smokler estimates that BLAD cost him $100,000 in losses, because he had to remove affected animals from his breeding herd.

"It was the most monetarily important recessive that we've ever had to deal with," he says. A key reason for the loss: 14 of 19 potential embryo donors in the herd tested positive for the disease. And the cows that tested positive—all but five—couldn't be used in embryo transfer breeding because of the risk of passing BLAD on to offspring.

Fortunately for Smokler and other Holstein farmers, Marcus Kehrli was listening closely to a presentation during a scientific meeting in 1989. Another researcher was discussing Leukocyte Adhesion Deficiency in humans, and Kehrli thought the symptoms of human LAD were similar to those of a calf that had died at the USDA-ARS National Animal

Disease Center in Ames, Iowa, where he works. So Kehrli and colleagues at Ames began to study the problem.

They determined that BLAD was caused by a genetic defect—that calves born with two copies of the recessive gene were, in effect, programmed at birth to die—on average, within 7 months—from pneumonia, diarrhea, or other common ailments.

"We think that eventually, through continued screening, we can eliminate the disease in the United States and around the world," Kehrli says.

The research led to three CRADA's, a patent, two patent licenses, and a genetic test that Smokler and others in the Holstein industry now use to screen their animals for the disease.

"We think that eventually, through continued screening, we can eliminate the disease in the United States and around the world," Kehrli says, noting that Holsteins account for about 90 percent of the milk produced in this country.

Holstein industry representatives have praised the work, saying it has had a positive impact.

"I think it has been a tremendous help for breeding purposes," says Irma Robertson, who is executive director of quality assurance for the U.S. Holstein Association in Brattleboro, Vermont. Testing for BLAD began in 1991. As of February 1996, the Holstein Association had recorded 13,238 animals as testing free of BLAD, while 2,933 were confirmed as carriers, she says.

Chuck Sattler, genetic programs administrator for the National Association of Animal Breeders in Columbia, Missouri, estimates that "if farmers were unaware of the condition and did nothing to avoid it, about 40,000 calves would die each year from BLAD complications.

Those calves would have had a potential value of about $10 million." Sattler says that, since the gene is recessive, breeders can use the test to avoid mating males and females that each carry the gene.

"BLAD is a major biotech success story," notes Chuck Allen, who is director of operations for Atlantic Breeders, Inc., based in Lancaster, Pennsylvania. The company, a farmer cooperative, produces Holstein semen for artificial insemination. "It has had a major positive impact on our business," says Allen.

In-the-Shell Vaccination for Chicks

More than 60 percent of the broiler chickens in the United States today are vaccinated as embryos inside their eggshells, before they hatch. The story behind this process is one of the best examples of ARS and a private company teaming up to help a rural industry improve its efficiency.

In the 1980's, ARS scientists at East Lansing, Michigan, developed a procedure for vaccinating chicken embryos against Marek's disease, which attacks the birds' nervous system and can cause death. All chickens with signs of this disease are rejected at processing plants—so all broiler chicks in the United States are vaccinated against it.

In 1987, ARS and Embrex, Inc., based in Research Triangle Park, North Carolina, entered into a CRADA—the first between a private company and a government laboratory, under the Federal Technology Transfer Act. Since then, six additional CRADA's have been signed with the company to expand the technology to protect chickens against avian coccidiosis, salmonella, and other diseases.

Embrex received an exclusive license to develop the technology, and the automated system the company introduced in 1992 can inoculate from 20,000 to 50,000 eggs per hour. The automated system has now been installed in 126 hatcheries in the United States and Canada, according to Embrex officials.

The company estimates that the automated vaccine system saves the U.S. poultry industry about $70 million annually. More than 7 billion birds are produced in the United States each year.

In Congressional testimony last year, the company said that "our small but growing company owes its existence to ARS research efforts." The company now employs about 100 people, in North Carolina and at small branch offices in Delaware, Georgia, and Arkansas.—By **Sean Adams,** ARS.

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