Show Me the Money

Why Economics Is Essential for Sustainable Agriculture

Farmers who want the best for their fields and families often have to balance ecological and financial concerns. So how do they choose the best equipment and management techniques to suit their needs? How do they know a new path will lead to profitability and sustainability—and not to regret?

ARS research across the country is helping to identify the best combinations of tools, crops, and management to balance the interests of stewardship and profitability.

Go With the Flow

U.S. policymakers have implemented several incentive programs to encourage farmers and ranchers to adopt conservation practices. Watershed models that simulate the effects of such practices are an important element of USDA efforts such as the Conservation Effects Assessment Project (CEAP). A multiagency program, CEAP is assessing how U.S. conservation programs benefit water, soil, air, and wildlife.

Jerry Whittaker, a hydrologist in ARS's Forage Seed and Cereal Research Unit at Corvallis, Oregon, is helping to develop a modeling system for use in CEAP and other ARS conservation research.

"The system determines the optimal trade-offs among conservation practices, producer profits, and water quality," Whittaker says. "An economic model chooses different management decisions, such as the amount of chemicals to apply. That information is fed into another model, which evaluates the effects of different economic decisions."

Whittaker is also speeding up economic analysis with a massive, custom-made parallel computer called a "Beowulf cluster." This is a very large, very fast, problem-solving computer—or rather, a cluster of inexpensive computers linked via an Ethernet, a sort of desktop "supercomputer."

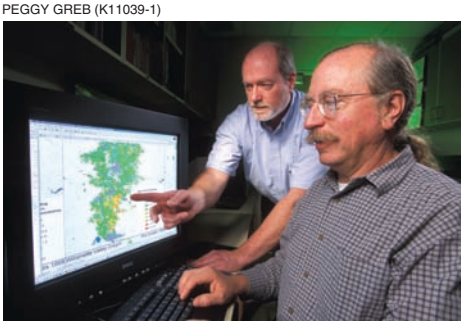
Whittaker joined 24 processors into a cluster capable of solving complex problems as rapidly as a commercial parallel computer—but for only a fraction of the cost. He then wrote software for the computer to apply to economic, statistical, and hydrological ARS research. The results from Whittaker's models will be used to inform landowners, government agencies, environmental organizations, and legislators about the benefits of various conservation programs.

Soil scientist Wayne Honeycutt examines a research plot of barley interseeded with red clover. Behind him are crops of mustard, canola, and sweet corn. These and other crops were evaluated by an interdisciplinary team of ARS scientists for their impacts on overall cropping system yield and quality, profitability, economic risk, soilborne diseases, nutrient availability, and other factors.

PEGGY GREB (D277-20)

Agronomist George Mueller-Warrant (front) and hydrologist Jerry Whittaker look at alternative locations for conservation practices in the Calapooia River watershed.

PEGGY GREB (K11039-1)



DAVE CLARK (D809-1)

Corn growing in a no-till field after "burning" down existing vegetation with herbicides.

How well does it work? In one study, Whittaker calibrated the ARS hydrology model to match the observed water flow out of a watershed. The objective was to choose the best levels of 155 parameters in the model to match the observed flow.

"Usually a scientist has to calibrate a model by changing parameters one at a time and judging the results," Whittaker says. This task would ordinarily take about 9 months. The cluster completed it in 4 days by optimizing all 155 parameters simultaneously—an impossible feat for a human.

Technology like this enables faster analysis of the effects of conservation practices. This, in turn, enables managers to quickly decide whether to continue, increase, or modify their efforts for maximum benefit.

High-Tech Farm Tools

"Assessing risk in economic terms means reducing variability," says Jason Bergtold. An economist at the ARS National Soil Dynamics Laboratory in Auburn, Alabama, he has helped develop several decision aids to help agricultural professionals make informed management decisions.

DAVE CLARK (D810-1)

Corn growing in a conventionally tilled plot.

New Markets for Potato Growers

In the late 1990s, ARS's only New England-based laboratory set out to get Maine's potato farmers back on their feet.

For nearly 250 years, the state has been an important source of potatoes. But five decades of generally flat tuber yields and increasing disease pressure in some fields had the state's potato growers feeling whipped. So naturally, Wayne Honeycutt, research leader of the New England Plant, Soil, and Water Research Laboratory in Orono, wondered how his lab could help.

At the top of the growers' wish lists? Beneficial, profitable crops that could be grown in rotation with potatoes. In addition to boosting income, such crops—canola, soy, sweet corn, green beans—could help save on costly chemicals by naturally snuffing out disease and enhancing the nutrient content of soils.

By 2005, the laboratory had compiled its rotation findings into the user-friendly Potato Systems Planner. (See *Agricultural Research,* December 2005, pp. 20-21.) More than 1,000 copies of this software package have since been shared with growers, extension specialists, and others across 24 states and 28 countries.

PEGGY GREB (D273-1)

Steve Crane (left), a Maine potato grower and member of the executive committee for the National Potato Council, and ARS agricultural economist John Halloran field test the Potato Systems Planner to identify the crop rotation sequence that minimizes disease and maximizes profit.

The planner software package provides information on 14 different crop rotations. Many of the region's growers now know, for instance, that canola is probably the superior candidate for knocking down tuber diseases such as stem canker and black scurf.

But to make these findings even more useful, it's important to define the market forces tugging on these crops. For example, what's the demand for canola and green beans? And where, regionally, is this pull strongest?

To answer such questions, Honeycutt and agricultural economist John Halloran are collaborating with USDA's Agricultural Marketing Service. "Working with them, we hope to identify marketing channels and opportunities for the rotation crops we've deemed beneficial," says Honeycutt.

Halloran also hopes to identify other unknowns relating to demand, such as which potato cultivars have the most desirable skin and flesh colors.

The push to buy locally is also a powerful force—one that small New England growers could use to their advantage. But how? "Through strategic alliances, including cooperative ventures and farmers' markets," Halloran says. "And by strengthening ties between local growers and the supermarkets and restaurants in their area."—By **Erin Peabody,** ARS.

Bergtold and colleagues are developing two user-friendly tools that will allow farmers to analyze the profitability of various management techniques: the Conservation Systems Learning Tool predicts how profitable various crops will be under different management systems; the Crop Profitability Calculator evaluates how factors such as management practices and conservation incentive payments influence the profitability of crop enterprises. It is being expanded to include more tools to analyze risk based on additional data.

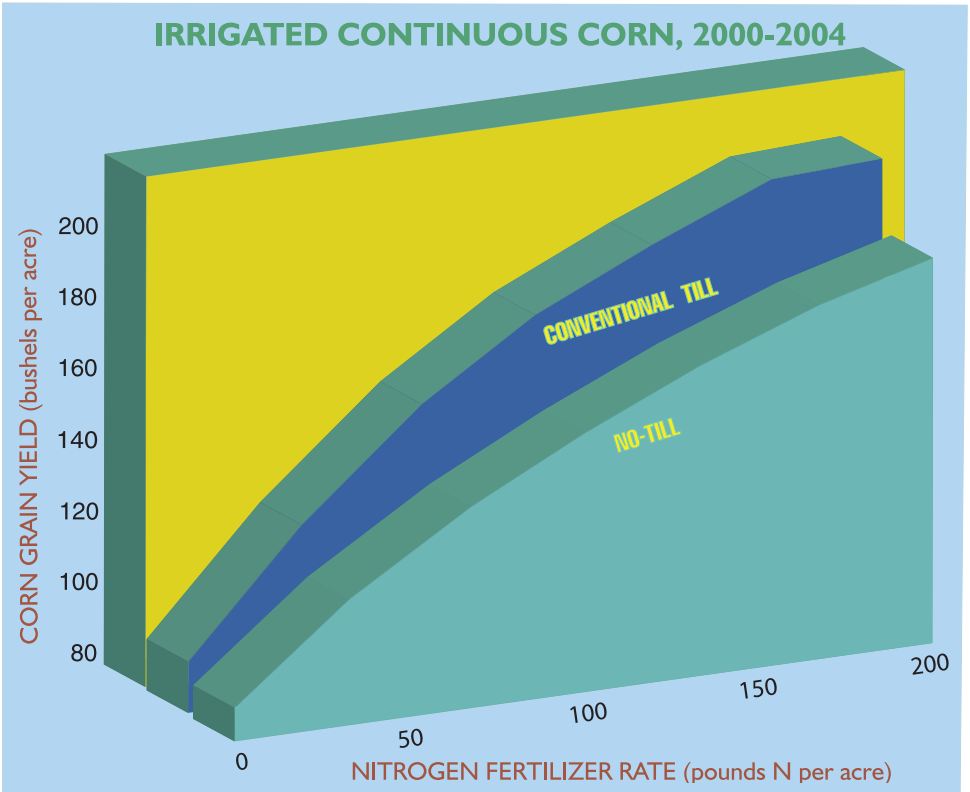
To identify the best way to transfer technology to farmers, Bergtold also investigates which factors affect whether or not conservation practices are "picked up, kept up, or stepped up," he says. He and his colleagues have nearly completed a study of how factors such as demographics, farm characteristics, management practices, and personal beliefs influence southeastern farmers who could qualify for economic support by adopting various conservation practices. Understanding what leads farmers to embrace conservation could benefit program developers, researchers, and policymakers, he says.

Less Fertilizer and Tillage, More Profit

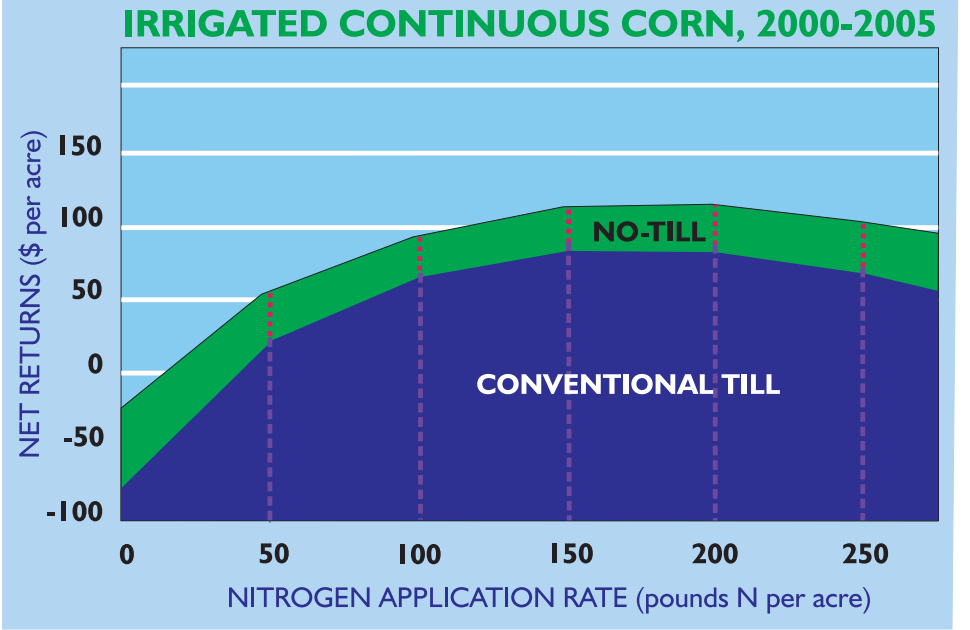
On a smaller scale, economic analysis can also reveal surprising truths about making agriculture profitable.

Because corn leaves a lot of crop residue, many growers till fields intensively when preparing for the next crop. To find out how tillage affects greenhouse gas emissions, soil scientist Ardell Halvorson, of the ARS Soil Plant Nutrient Research Unit in Fort Collins, Colorado, and Arvin Mosier, formerly with ARS, measured trace gas flux over a 3-year period in three cropping systems: conventionally tilled corn, no-till continuous corn, and a no-till corn-soybean rotation.

They worked with other ARS colleagues to gather and analyze the data. The team found that with adequate fertilizer, the no-till system sequestered more soil carbon than the conventionally tilled system and reduced greenhouse gas emissions.



Higher yields from conventional till (above) could mistakenly convince growers to avoid no-till, which is actually more profitable (below).



For 5 years, Halvorson and his colleagues also measured the effects on yield of nitrogen fertilization and tillage—both conventional and no-till—on irrigated continuous corn. They found that no-till management had multiple benefits, such as reducing soil erosion and fossil fuel consumption, sequestering carbon in the soil, and lowering emission of greenhouse gases. But it also lowered yields—by about 23 bushels per acre at optimal nitrogen rate.

The initial results made conventional tillage look like the better economic strategy, but further analysis revealed a surprising twist. David Archer, an ARS economist then located at the North Central Soil Conservation Research Laboratory in Morris, Minnesota, found that no-till was actually *more* profitable than conventional tillage.

Using a statistical model, he determined that no-till management increased net profits by significantly reducing machinery and labor costs and fossil fuel consumption. Net savings were about $83 per acre—enough to compensate for the lower yields and still return about $29 per acre more than the conventional till system.

"The economic benefits for farmers using these conservation practices could be even greater when participating in USDA conservation programs," says national program leader Jeff Steiner.

Sustainable agriculture sounds great in theory, and by identifying the most ecological, profitable, and practical management decisions, ARS research efforts like these will ensure that it works in practice as well.—By **Laura McGinnis,** ARS.

This research is part of Agricultural System Competitiveness and Sustainability, an ARS national program (#216) described on the World Wide Web at www.nps.ars.usda.gov.

To reach the scientists mentioned in this article, contact Laura McGinnis, USDA-ARS Information Staff, 5601 Sunnyside Ave., Beltsville, MD 20705-5129; phone (301) 504-1654, fax (301) 504-1486, e-mail laura.mcginnis@ars.usda.gov. ✸

Software Helps Farmers Make Profitable Decisions

Born in a farmhouse that has been in his family since 1866, Marshall Lamb was destined to farm. Eventually, he extended his farming experience to include formal studies in agricultural economics, earning a doctorate in 1995. Then Lamb joined the National Peanut Research Laboratory (NPRL) in Dawson, Georgia, and soon became involved in developing a collection of farm-management software for peanut farmers.

The lab's software work began in the 1980s, long before Lamb's arrival at NPRL, with a program called "Irrigator Pro." Developed by mechanical engineer James Davidson (now retired), in collaboration with peanut farmers and the Peanut Foundation, its objective was to improve economic returns and reduce risk for irrigated-peanut production.

"That software significantly improved management efficiency by giving growers an objective way to make decisions," says Lamb.

A stream of software programs, referred to as "FarmSuite," soon followed: HarvPro, Peanut Curing Manager, Capital Investment Program, Sprinkler Cost Program, and ultimately, WholeFarm.

"WholeFarm steadily evolved as we listened to the problems of peanut farmers and shellers and looked for ways to solve them," says Lamb. But, he points out, "WholeFarm isn't just for peanuts. It can be tailored to other commodities, like cotton and corn."

WholeFarm lets a grower build details about the farm into the computer and analyze situations that could affect production success. It's then possible to see which crops might raise profits and how changes in crop prices would influence farm income, cashflow, and the yields needed to break even. Even equipment purchases can be figured into the estimates.

FarmSuite also generates moisture, temperature, and cost-monitoring graphs, includes predictive software routines to help farmers plan more effectively, and provides recommendations on a future course of action.

Lamb and the NPRL team are considering making the program Web based for easy use by a variety of growers.—By **Sharon Durham,** ARS.

PEGGY GREB (K11576-1)

Agricultural economist Marshall Lamb and plant physiologist Diane Rowland check crop water-use sensors used in irrigation scheduling methods developed at the ARS National Peanut Research Laboratory.