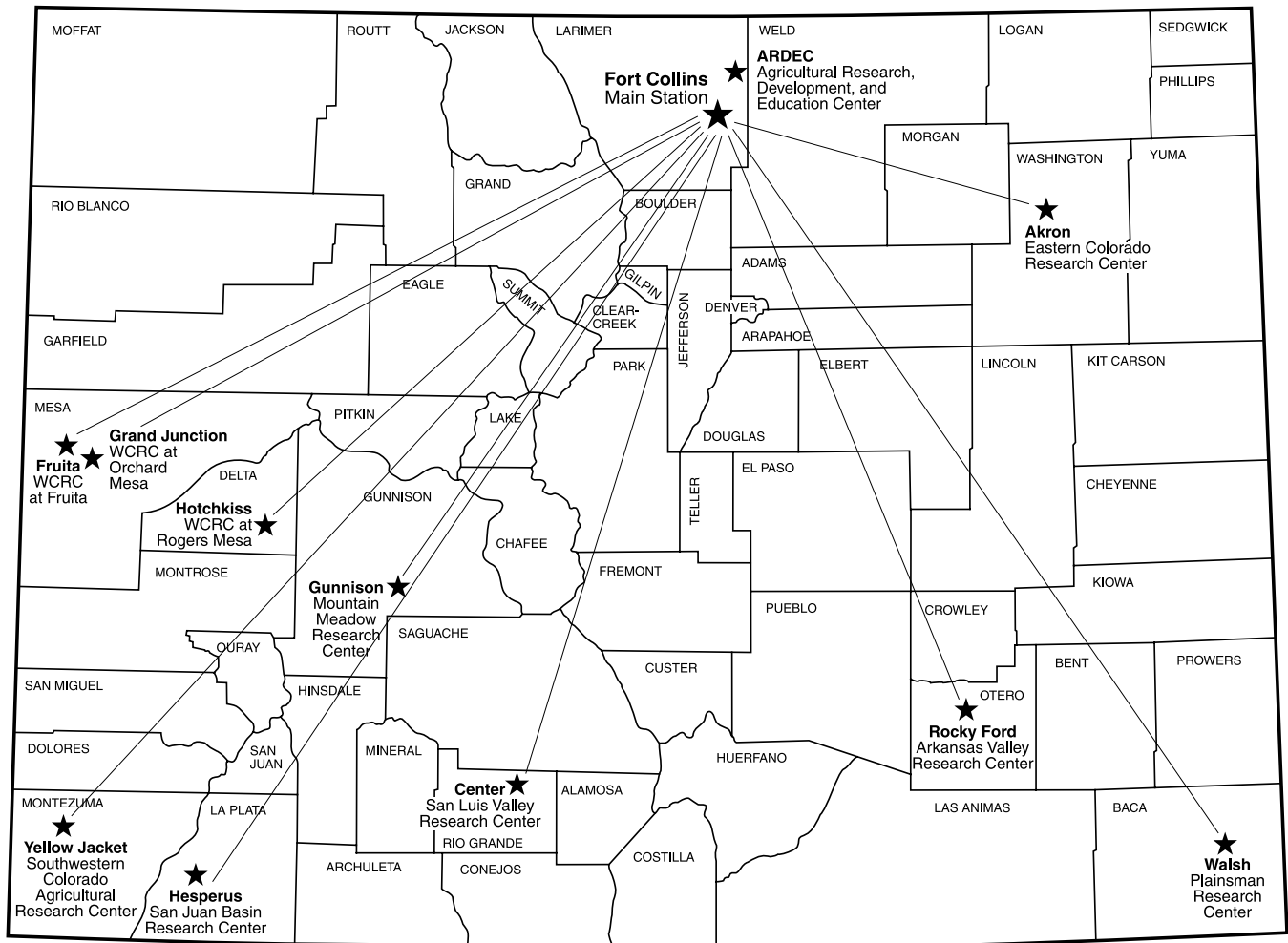


Colorado
Agricultural
Experiment
Station
Annual Report
2000

Colorado
State
University

Knowledge to Go Places

Colorado Agricultural Research System



The Colorado Agricultural Experiment Station 2000 Annual Report was produced by the Colorado Agricultural Experiment Station, Colorado State University Outreach Communications and Technology, and Colorado State University Publications and Printing.

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The Agricultural Experiment Station at Colorado State University developed this annual report to summarize the results obtained by a selection of our ongoing research projects. As an integral part of

Colorado State University, the Agricultural Experiment Station is committed to implementing the land-grant mission by conducting research on the agricultural and environmental needs of the people of Colorado, the region, and the nation. Our mission is to support research leading to an agriculture that is economically viable, environmentally sustainable, and socially acceptable. Our agricultural research efforts extend across the entire campus involving faculty and staff from 27 academic departments in 7 colleges and 11 off-campus research centers. To address the complex problems facing agriculture, it is essential that academic departments work in concert with each other to solve problems through interdisciplinary efforts.

The diverse program supported by the Agricultural Experiment Station can be characterized in six broad program areas:

- Plant and animal improvement and new agricultural product development
- Systems for producing, processing, and marketing agricultural products
- Safe and effective management of pests
- Food safety and nutrition
- Agriculture and environmental quality
- Rural and community development

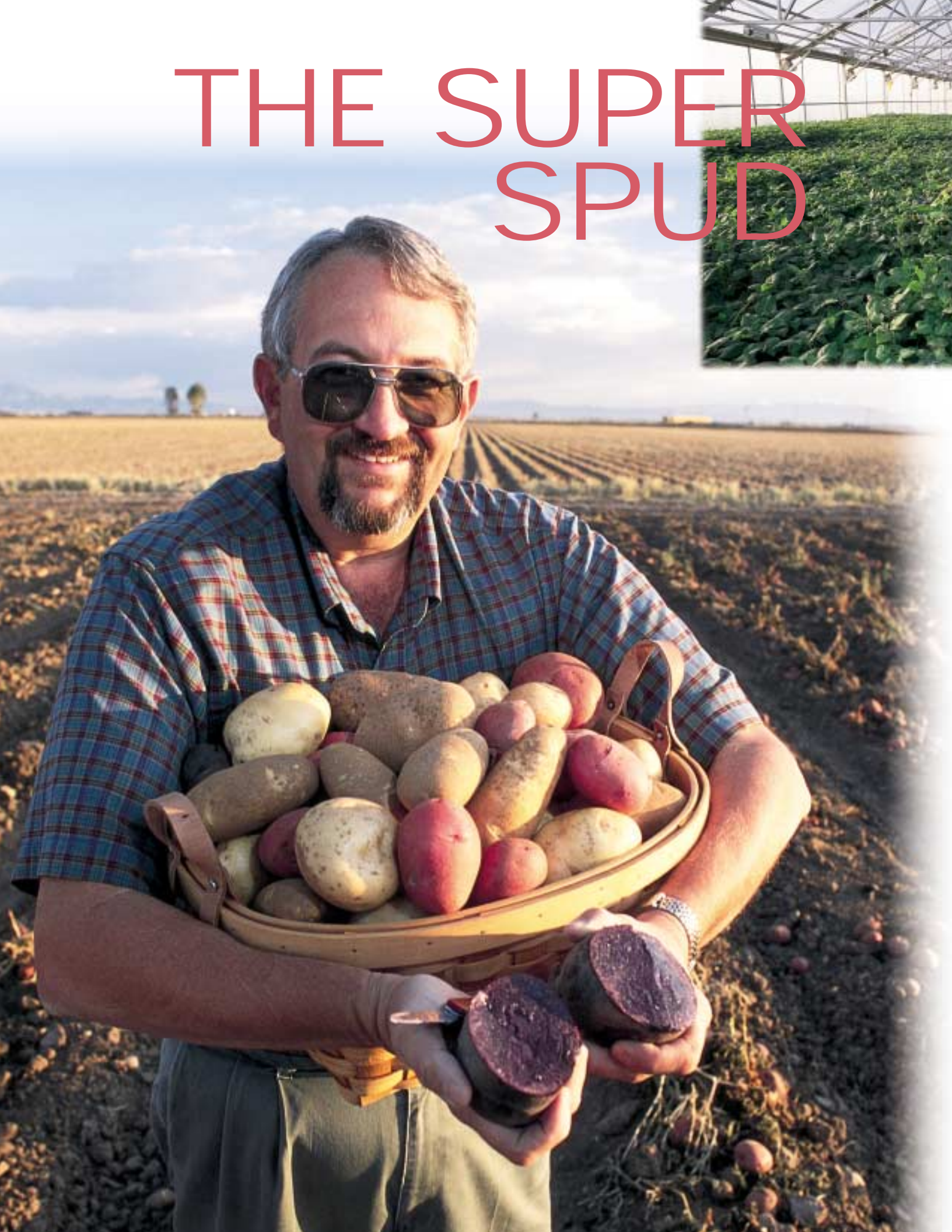


In cooperation with Cooperative Extension and the State Forest Service at Colorado State University, an initiative to the State Legislature has been developed to enhance funding for our research and extension programs. Through a process involving constituents and advisory groups, seven critically important areas have been identified and prioritized. This three-year initiative will provide base-funding support to address issues resulting from the continued population growth and changing nature of agriculture in Colorado. The areas targeted for enhanced funding beginning in Year 1 of the initiative are forest health and interface, invasive plant species on public and private land, and increased extension staffing in selected counties. Four additional topics will be addressed beginning in Years 2 and 3 of the initiative: animal agriculture and environmental quality, development and the structure of agriculture, safe food for Coloradans, and water issues in Colorado. This base-funding increase would significantly enhance the ability of our researchers to address issues of importance to Colorado agriculture.

I hope you enjoy this report. Please contact me if you have any questions concerning our research programs at Colorado State University.

Lee E. Sommers, Director
Colorado Agricultural Experiment Station
at Colorado State University

THE SUPER SPUD





Development of new potato varieties

In Colorado, the potato industry is not small

potatoes. In fact, Colorado is right behind Idaho as one of the top potato-producing states in the nation. That's due, in part, to the work of the Colorado State University Agricultural Experiment Station in the San Luis Valley, an area known for its pristine conditions for growing high-quality crops, among them potatoes. Because of these near-perfect conditions for growing potatoes, the San Luis Valley also has become a top production area for quality seed potatoes used by farmers in many other states such as California and Texas.

David Holm, professor of horticulture and landscape architecture, came to the San Luis Valley Research Center (SLVRC) in 1978. He grew up on a potato farm in Idaho, and when he first visited the San Luis Valley, he knew that it was a pace-setting place for the potato industry in the United States.

"I knew that the San Luis Valley could out-produce other areas with higher-quality potatoes," says Holm. "The area is at the right altitude with high light intensities, which translates into moderately warm days and cool nights, which is perfect for potatoes. The area has low disease rates and no Colorado potato beetles. It costs less to produce a better crop here."

Since 1978, potato production in the valley has doubled. The area continuously produces top-quality potatoes. Quality is based on external appearance of the potato (freedom from cracks, nobs, or off-shapes) and freedom from internal problems such as hollow areas and discolored or brown areas. The appearance and internal quality of a potato are large factors in the consumer market and depend primarily on the variety of the potato. A variety without defects means that it will be more acceptable to consumers.

Finding and developing new varieties has been the foundation of Holm's success. His research centers on

developing new potato varieties with increased yield, improved quality, resistance to diseases and pests, and tolerance to environmental stresses. A primary emphasis also is placed on developing potatoes that are more inexpensive to grow because they require less fertilizer, pesticides, and other production inputs.

Through the years, Holm has developed many varieties, some of which are staples of the industry today. Chances are, for example, if you bite into a Frito Lay potato chip, you're eating a Chipeta potato, a variety developed in the San Luis Valley for the potato chip industry. And, yes, there is a difference between a potato-chip potato and a baking potato and a french-fry potato. Chipetas are the right density for a potato chip, and they have lower sugar levels so they don't turn too brown when they are made into chips.

Russet Nugget potatoes, on the other hand, make perfect french fries. They, too, have lower sugar levels. They're also high in specific gravity, or dense, which makes for a better quality french fry. This San Luis Valley variety has been sliced and fried by fast-food chains since 1988.

Then there's Ute Russet. Holm said that although this variety didn't catch on in large markets, the fact that growing it requires little fertilizer and that it is more tolerant of potato diseases makes it popular with organic potato growers.

The Sangre, a red potato, was developed to be more attractive and to hold its red color longer during storage, making it more attractive to buyers in the grocery store.

What does the future hold? The challenges are never-ending. The introduction of the potato late blight and other diseases into the San Luis Valley in recent years will be the next challenge Holm tries to tackle. Finding a variety that is resistant to these diseases – or even better, immune – would help assure that the potato industry in Colorado will remain productive and in a competitive position.

He'll also look at specialty varieties such as potatoes with yellow, red, dark purple, or some other color hiding underneath their skin. Imagine the fun a bag of Frito Lay chips would hold for a consumer then.

"We just try to help the grower by making them more productive and profitable, and we involve the growers as much as possible," said Holm. "I've seen varieties come and go. Time will tell which ones are successful. We just try to develop the super spud."

HIS MARRIAGE/ HER

Sharing
emotional
tasks

With modern
times have come
modern households;

MARRIAGE

it's not uncommon for a man to

wash dishes, fix dinner, or stay at home

with children while his wife becomes the breadwinner. But is the modern relationship really all that modern?

Alicia Cook, professor of human development and family studies, isn't convinced that the roles between males and females have become as flexible as they appear to be at home or at work. Although traditional domestic chores might be shared, the emotional chores aren't.

"Although it's not traditionally thought of as work, providing emotional support in the home or even on the job takes effort," says Cook. "And sharing that type of work – offering solutions to a problem, encouraging your spouse, lifting spirits, maintaining optimism – is just as important to a marriage as physical tasks such as cleaning, mowing the lawn, preparing meals, and paying the bills. It's that type of effort that sets the tone for the rest of the family."

In fact, Cook and her colleague, Peggy Berger, professor of design and merchandising, found in several different studies that couples who share equally in emotional tasks are more satisfied with their marriages. This is especially so for husbands; those who say they take more responsibility for the emotional climate of their home are more satisfied with their marriage. On the other hand, women also are more satisfied in their marriages when their husbands take on as much responsibility for emotional tasks as they do.

And this type of task is work – it requires effort, time, and energy, although most people don't think of it

as such. An imbalance in this kind of task in a marriage or on the job tends to negatively affect women more than men, Cook adds. That could be because, in general, women tend to do more emotional tasks than men.

In fact, when Cook and Berger looked at work and family role spillover of people in careers primarily occupied by the opposite gender – for example, female engineers or male nurses or in occupations that required extensive emotional support for either gender, such as therapists – they found that women, regardless of occupation, still tend to provide more emotional support at home than do males.

Females also provide more emotional support on the job. Female leaders and managers who were investigated by Cook and Berger tend to be more in tune with and supportive of their co-workers' and employees' emotional needs. For example, female bosses tend to praise, support, and encourage their employees more. They're also more attuned to building teams, reconciling internal disputes, and solving work satisfaction and personality problems at work.

"We started to wonder if there's only a certain amount of emotional energy people can give," says Cook. "If someone uses all of his or her energy at work, does he or she have any to give to family members? Or if they use it all to support their families, do they have any support left to give on the job? What we found is that it's reciprocal. It's not just what someone does, it's the response they get from it. If one's spouse or co-worker appreciates the emotional efforts one gives them and shows appreciation, the more energy the first person has to give more support."



TOO GOOD TO

Manure
management
researcher
finds new
uses for a
valuable
resource



WASTE

At one time, agriculture was a self-sustaining cycle. Farmers grew crops, which they used to feed their livestock, and they fertilized

their cropland with the nutrients in the animal manure. But with the advent of large-scale animal feedlots, the cycle was broken, says Colorado State University soil and crop sciences Associate Professor Jessica Davis.

“Today, livestock producers bring in feed from other places,” Davis explains. “Some nutrients leave the operation as meat or milk, but a large portion of the nitrogen and phosphorous stays right on the feedlot as manure.”

Some livestock producers are increasing the number of animals on their feedlots without increasing their acreage. In northeast Colorado’s feedlot-intensive South Platte River Basin, the groundwater is becoming critically contaminated with nitrogen due in part to the concentration of animal manure in localized areas.

The U.S. Department of Agriculture and Environmental Protection Agency recently developed a new strategy encouraging all animal feeding operations to develop and implement voluntary, comprehensive nutrient management plans. So, when livestock producers make plans to expand their operations, they need to plan not just for where the cattle are penned and fed but for what to do with the extra manure, as well.

“Producers with an inadequate land base need to develop a marketing strategy for getting the manure off their land,” Davis says, “and this represents a new and different approach. The problem the industry is facing is that people are willing to pay to ship corn to cattle, but not to ship manure to corn.”

Davis, working in cooperation with Mike Lacy, associate professor from the Department of Sociology, and Dana Hoag, professor from the Department of Agricultural and Resource Economics, recently surveyed more than 250 farmers and ranchers in Weld County, which has the heaviest concentration of livestock in the state. They learned that manure is being

valued primarily not as fertilizer for its nitrogen content but as a soil amendment that improves soil quality. Since manure is often not valued highly by farmers, feedlots generally can’t afford to haul it more than five miles from its source.

Davis suspects that if manure were more widely used for high-value uses, like soil remediation, the industry could afford to haul it farther, resulting in improved soil quality in one place and reduced contamination at the source site.

“Many farmers already know that if they have poor or eroded land with low crop yield, application of manure would be a great way to remediate the soil,” she says. “But there is often not enough manure close by to make it affordable. So we need to figure out what we can do to increase the value and therefore the transport distance of manure.”

Davis currently is working with Cooperative Extension and Natural Resource Conservation Service field staff in six states to provide a series of workshops designed to help livestock producers and farmers make better decisions about manure management. Each participant will develop a comprehensive nutrient management plan specific to his or her operation, including strategies for the collection, storage, utilization, and marketing of manure. The workshop materials also will be placed on a Web page so that livestock managers with operations of all sizes can benefit from the information.

“Manure accumulation is a problem not just for feedlots but also for small-acreage horse owners,” Davis warns. “Some people are hauling manure to the landfill and actually paying to get rid of it. Manure is too good for this.”

According to Davis, a good option for manure disposal is through a composting co-op. Under such an arrangement, a group of animal owners would bring all their manure together for composting, resulting in a product they could sell rather than one they need to pay to get rid of.

“Composted manure is great for landscaping and could be of value to an increasing Front Range population trying to garden on poor soils,” says Davis. “Another potential market for composted manure is organic farmers, who don’t have many environmentally acceptable or locally effective options for adding nutrients to the soil. Mine spoils also could benefit from manure, as could soils burned by wildfire. We shouldn’t be wasting this valuable resource on the landfill.”



DRY BEANS

Working magic with beans and other crops is not a fairy tale





He's a jack-of-all-trades. And a little like the Jack of *Jack and the Beanstalk*. And when beans are involved, he's a bona fide bean counter.

Calvin Pearson is a blend of these characters, although he doesn't work in a fairytale land far, far away. His kingdom of sorts is most of western Colorado, where he sometimes works magic with beans, along with many other crops.

But his work isn't at all full of beans. Pearson is a soil and crop science professor at the Western Colorado Research Center at Fruita, where he works with farmers and ranchers to find new, profitable crops and to breathe new life into old crops. Those crops range from the staples of beans, alfalfa, corn, wheat, and barley and extend to more exotic crops such as poplar trees and kenaf.

"I work to meet the many and varied interests of farmers in a large area of Colorado," says Pearson. "Yesterday, I helped a minister down the road find something to grow on his two acres that would compete against weeds. I also work with farmers in northwest Colorado to help make their farm operations more profitable."

Although Pearson's projects are numerous and broad, one of his largest and most successful is the Foundation Dry Bean Seed Project. The project produces high-quality seeds for bean growers in Colorado. The dry bean business is a multimillion dollar industry, so Pearson is always looking for new varieties and techniques to help farmers take advantage of that market.

Low humidity and a lack of violent storms are some of the

conditions at Fruita that make it a perfect place to grow seed stock for new varieties of crops. Pearson and others at the research center can take a small amount of seed and, from them, after a year or two, produce enough seeds to grow acres of the crop.



They've produced premium seed beans for the Foundation Dry Bean Seed Project for years, along with seeds for other crops. In addition to researching and developing exceptional seeds, Pearson also

investigates other areas of crop production including fertilizer, tillage, and crop rotation approaches.

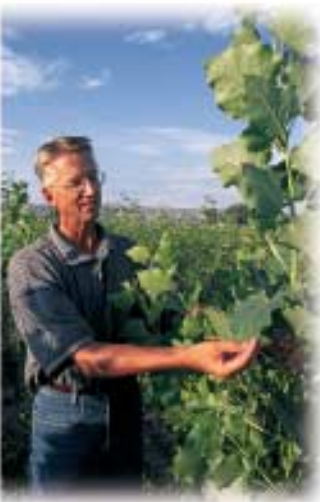
He also works with others to create markets for the crops he researches. For example, he's worked with Coors and barley farmers in western Colorado and is working with other companies, encouraging them to come to the area to produce new and alternative crops in western Colorado.

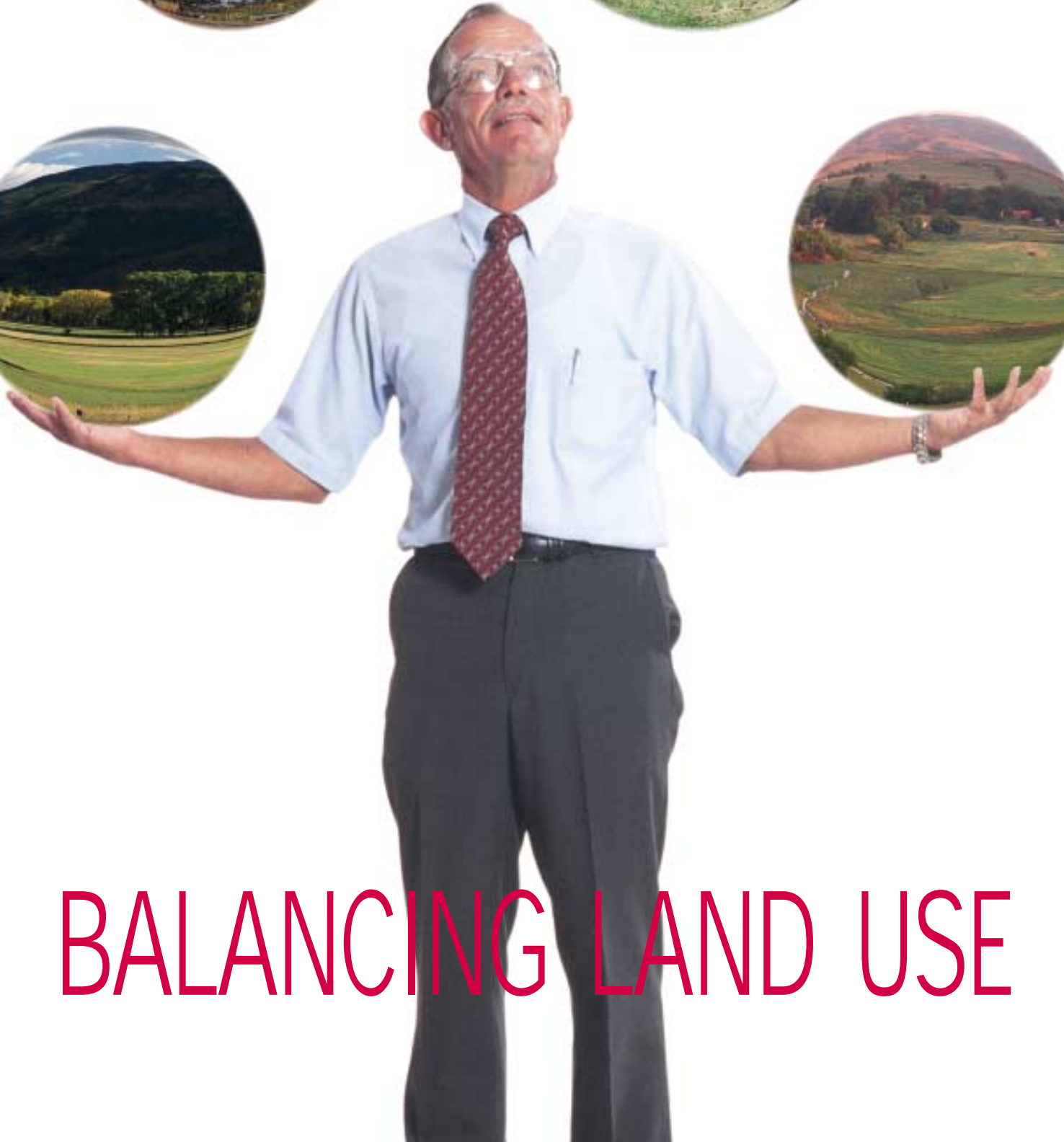
He investigates all components of these crops' profitability, from the best seeds to grow, to finding a market for them, and to getting the commodity sold to companies who will turn them into a product.

"We have our misses," he said. "Some things we've tried didn't work. But other things do – like the snap beans we are bringing into Colorado to meet a market demand and the premium alfalfa seed we're producing. Just one aspect can kill an industry, even if 100 other things are perfect. For example, we did a great job of growing soybeans on the Western Slope, but because of low market prices and high transportation costs, it was cheaper for food companies to ship soybeans from Kansas to the West Coast via the railroad than it was for them to ship them from western Colorado. We are careful with every endeavor; we go in with our eyes wide open and expect curve balls along the way."

"Farmers all over the United States are struggling, they're scrambling to find profitable crops," said Pearson. "I try to find commercial commodities and give producers tools to grow high-quality, specialty products, because if you give consumers a higher-quality product, they're often willing to pay more for it."

And that, to many farmers, is worth more than just beans.





BALANCING LAND USE

Public land management Risk and uncertainty are inherent in the Western cattle industry. Natural events such as severe weather or disease

outbreaks can easily spell disaster.

There are man-made disasters as well. Public policy decisions over the management of public lands can affect ranchers profoundly. Largely driven by population growth in the West, recent land-use policy trends are making the future loom as uncertain as dark clouds on the horizon for Western cattle ranchers.

Colorado State University rangeland ecosystem science Professor E. T. Bartlett, University of Wyoming Professor Larry Van Tassell, and U.S. Forest Service range scientist John Mitchell are trying to dispel some of those dark clouds – with mixed results. A recent study by them has concluded that public land grazing in the West will decrease over the next 50 years. Urban sprawl, suburbanization, recreation, wildlife use, and allocation of lands for nonagricultural conservation use will limit livestock forage on public land – particularly mountain livestock production. That finding, combined with the fact that public land grazing provides the basis for much of the West’s livestock production, leaves little doubt that the region’s cattle industry will be affected.

But there is a silver lining as well: By foreseeing this likely outcome, planners have time to develop likely alternatives to public land forage and to prepare ranchers and communities for the inevitable impact.

One thing most people don’t realize, says Bartlett, is that ranchers in developing counties could have more alternatives for forage than those in counties with a traditional agricultural base. “In some areas, ranches have been bought with an eye toward development, but they haven’t been developed yet, and the forage is still

available,” he explains. “We’re also seeing more large homesites with a lot of open land, and these owners could be willing to lease their land for grazing to reduce fire hazards and to manage weed infestations.”

With graduate student Helen Rowe and Cooperative Extension faculty DeLaine Brown of Moffat County, and CJ Mucklow of Routt County, Bartlett currently is exploring how public land policy changes would impact a developing county versus a traditional county. Next, Bartlett will work with faculty from Colorado State’s Department of Sociology to determine what sociological impacts federal grazing policies will have on rural communities.

“This is an area that has not been looked at before,” says Bartlett. “In the end, we will have a new methodology available so that communities can examine economic and social impacts and plan the future direction of land use in their county.”

The recently completed study is part of a unique project sponsored by the U.S. Forest Service in cooperation with Colorado State University and the University of Wyoming. This study and others like it have been an outcome of the Western Coordinating Committee on Range Economics (WCC-55), in collaboration with the Western Association of Agricultural Experiment Station Directors and the USDA Cooperative State Research, Education, and Extension Service.

A recent outgrowth of the WCC-55 is the Policy Analysis Center for Western Public Lands, which is funded by the Agricultural Experiment Stations of the western states. The center’s advisory board, made up of interest group representatives and users, will decide which of the most pressing issues of the day should be addressed. Scientists then will be called upon to produce in-depth research and intensive studies.

“What is critical is the fairly quick turnaround time, because people need information 30 to 60 days before a decision is made,” Bartlett says. “Questions need to be answered while they are still relevant so people can make informed decisions.”

In time, the Policy Analysis Center for Western Public Lands will help land-grant institutions like Colorado State respond to people’s information needs concerning public land issues in a more timely way and, hopefully, make those clouds on the horizon just a little less threatening.

TO FOLLOW . . .

Most masters
make mosaics from
small pieces of glass or tile,
sometimes dedicating years to

one big picture. Gary Peterson and Dwayne Westfall, Colorado State University soil and crop sciences professors, work within a mosaic of nature, using little pieces of a rain cloud here, sandy soil or a dab of evaporation next, and holding it all together with the seeds of a crop. Like most who make mosaics, they've spent years finding small pieces that make a big picture.

For Peterson, building the big picture started with the search for an answer to one small question. Fifteen years ago, a student in his soil management class asked him if crop and soil data from one part of the state applies to other parts of that state. Peterson had to tell him that he didn't really know.

"There was no way to expand data from one region across different climates and conditions," says Peterson. "So I started to look at consistent variations across crops within certain climates."

Peterson and Westfall chose several plots on farms scattered across most of eastern Colorado to conduct a study. They started testing crop production and the soil's moisture retention with different crop cycles. Each of the test plots had three different soil types.

"Once we had the data about how to manage soil in all of these different conditions," says Peterson, "I could start to answer the student's question."

First, they tested results with the most common crop rotation: wheat fallow, i.e. – plant wheat one year, no crop the next.

"If someone fallows well, they only save about 25 percent of the rainfall. The rest is lost to evaporation,



Crop and soil
management
systems in
dryland agro
ecosystems



runoff, or weeds,” said Peterson. “Farmers fallow to save water, but as they till the land, they expose it to evaporation because moist soil is turned to the top of the ground. Even with herbicides to control weeds, fallow is an insufficient situation.”

The researchers set up crop rotations with less fallow. They started with one year of wheat, then corn, then fallow; on another plot, they tried wheat, corn, proso millet, then fallow.

They discovered that the fewer years of fallow in a rotation, the more productive the land. They developed the opportunity crop system – plant a crop every year – a concept foreign to traditional farming but which requires more intensive management.

“Another problem with fallow, especially after a wheat crop, is that few crops put much organic matter back into the soil,” said Peterson. “We wondered if growing crops and decreasing fallow leads to higher organic matter. The answer is yes.”

Peterson and Westfall use no-till to maximize water conservation and organic matter accumulation. The soil is only stirred when a new crop is planted, which preserves organic matter and moisture. Fertilizer is added as needed. Herbicides control weeds between harvest and planting.

“After 15 years, we have solid conclusions,” said Peterson. “Growing a crop every year is the most productive system. Grain production jumped by up to 75 percent, and profit went up 25 to 40 percent. No one needs to fallow. It’s a win-win deal. Save water, produce more crops, make the soil more productive. Farmers come out ahead.”

But even with these solid answers, Peterson and Westfall continue to piece together a mosaic of information from Colorado’s farmlands. The weather, as always, affects a farmer’s profits. The smaller pieces like evaporation, erosion, and altitude do, too. They hope that long-term experiments will continue to provide more information so farmers can learn from the long-term effects of crop rotations.

“In England,” says Peterson, “there is an experiment that’s been going since 1840. Some things you learn over time can’t be learned any other way.”

OR NOT TO FALLOW

TAKING ADVANTAGE

People like to get the most for their money. Just about everybody is concerned about how tax money is spent.

Dana Hoag, Colorado State University agriculture and resource economics professor, sees this as an important question: Is agricultural research a good investment? It's a fair question, since taxpayers pay for most agricultural research at universities and government departments.

Hoag found that agricultural research is one of the best investments around. It's earned a 30 to 90 percent return each year for more than 50 years. In fact, American farmers produce two-and-a-half times more per dollar spent on food production than they did 50 years ago because of research discoveries. And Americans get food at a bargain price, compared to other countries. They spend just 11 percent of their income on food, leaving almost 90 percent of their money for enriching their lives through art, environment, safety, education, and more.

There are two types of research: applied and basic. Applied research has a specific outcome in mind, such as how a specific disease can be cured. Basic research provides answers to general riddles, such as how to map DNA.

"Both types of research are important, but you can't have one without the other," said Hoag. "Basic research gave us the ability to understand DNA. That's critical. With an understanding of DNA, applied research gives it boundless uses – overturning wrongful death convictions, breeding better animals, curing illnesses."

So who should be paying for this information – taxpayers or private companies that financially benefit from products based on a research discovery? Both, says Hoag.

"A private company has to be able to capture the benefit of research and make a profit," said Hoag. "If a

discovery benefits everyone, such as the map for DNA, it's hard to capture that general information and make it into something profitable without applied research. You can't easily turn mapping DNA into a marketable product, but you can turn the specifics of that information into thousands of products. If the government and universities don't do basic research, chances are basic discoveries by private companies won't be attempted or shared to benefit everyone because of their pressure for profit."

Universities, however, are spending less money on basic research, too, because of pressure to produce applied results. "We're giving basic research less and less attention, but it's proven to be more beneficial than anything out there," said Hoag. "The returns of basic research are almost twice as high as applied research."

It's all about perspective, says Hoag. One reason he believes that public funding for basic research is declining is because our society takes basic comforts – such as an abundant, affordable, high-quality food supply – for granted.

"We wouldn't be as concerned about things like the environment or social justice if we didn't have enough to eat," he said. "Our success allows people to take us for granted. We're so good at providing food, people don't realize the value of it. But there is more and more strain on farmers and ranchers to produce more and more food with less money, land, water, and support. Ask yourself, what are the benefits of cheap, high-quality food because agriculture is so successful?"

Farmers and ranchers are more productive than ever because research gives them better seeds, better fertilizer, better equipment. And they produce more with less fertilizer, labor, and water, which also benefits the environment.

"Had we not done all of the past research, could we feed all of the people we have now?" asked Hoag. "Imagine all of the extra acres we'd have to plow to provide for people if we hadn't learned to be more efficient."

"Farmers and ranchers should be proud of their accomplishments, and society should know that it's making a good investment," said Hoag.

OF A GOOD THING

Agricultural research is a wise investment



SALINITY, THE SILENT KILLER

Researcher looks for causes and solutions to the devastating effect salinity has on irrigated agriculture



The earliest known South Asian civilizations flourished in the Indus Valley from 3000-1500

B.C. in what is now Pakistan and India.

The Indus Valley Civilization covered a 600,000-square-mile territory and included well-planned, major cities boasting large public buildings and underground sewers.

Though the valley was sacked and pillaged by invaders around 1500 B.C., archaeologists agree that the real decline began several hundred years earlier. They also know the reason: saline soils. Salinity, or excess salt in the soil profile, is often called the “silent killer.”

The decline of agricultural civilizations due to soil salinity has been repeated countless times throughout history. Now, salinity is taking its toll on agricultural regions in the state of Colorado.

The Arkansas River in southeastern Colorado is one of the most saline rivers of its size in the United States. Salinity levels increase from 300 parts-per-million near Pueblo to more than 4,000 parts-per-million at the Colorado-Kansas border.

The Arkansas Valley has lost thousands of acres of agricultural land to salinity. Salinity problems now are beginning to show up in the South Platte River Basin, especially in Weld County, which is one of Colorado’s most productive agricultural areas.

Luis Garcia, Colorado State University associate professor of civil engineering and interim associate director of the Colorado Agricultural Experiment Station, is studying salinity in the Arkansas and South Platte river basins. Garcia is monitoring fields to determine where salt accumulates and how it impacts crops.

“The salinity problem is farther along in the Arkansas Valley, and the impacts are more acute with respect to agriculture,” says Garcia. “By studying the Arkansas, we hope to get an understanding of what might happen in the South Platte and, more importantly, what solutions the industry can implement.”

In some cases, Garcia says farmers might need to change irrigation methods, add drains to their land, or reduce seepage from canals. Other options include planting crops that are more salt tolerant or those that use less water.

“It’s also important to figure out where the salt is coming from,” says Garcia. If the salt is contributed by subsurface return flows from the irrigated fields, then better field management to reduce leaching will help.

“If the problem is created outside of a particular farm, an individual farmer might not have enough control to implement effective changes,” Garcia explains. “It requires resources outside of individuals to look at this issue on a larger scale.”

Colorado State University Cooperative Extension and the Natural Resources Conservation Service currently are working with farmers and local communities in a coordinated effort within the typically independent agricultural industry. Using Geographic Information Systems (GIS), salinity measurement devices, and groundwater monitoring wells, an accurate picture of the distribution of salinity in individual fields and over time can be produced for farmers.

Garcia and others are producing maps of saline fields showing groundwater and soil salinity levels as well as crop yield reductions that change with time, reflecting an accurate picture of salinity problems. This information can be used to change irrigation timing and amounts, as well as identify sources of saline waters that reduce productivity. For examples, see the Web site for the Arkansas project at <http://www.ids.colostate.edu/projects/arkansas>.

“Farmers along the lower South Platte River already are experiencing declining productivity of their fields due to increased salinity,” says Garcia. “When the salinity levels were low, the problem was masked by other issues. Now that the problem is becoming more widespread, farmers are becoming more aware of the possible long-term implications. They also are realizing that solutions need to be long-term.”

With those realizations, Colorado agriculture is learning the lessons of history the hard way; it’s not easy trying to grapple with a problem that has beaten so many in the past. Garcia hopes his work will help guarantee a better chance for the future.



SOIL IS NOT A

Colorado State University soil and crop sciences Associate

Professor Gene Kelly wants you

to know that soil is not a dirty word. As a critical factor in the structure and functioning of ecosystems, soil patterns help determine where certain kinds of plants and wildlife can live. Soils also help determine what areas are safe or unsafe to build homes or other structures.

Even so, soil, or dirt, gets “no respect.” You can get your face rubbed in it, your name dragged through it, or you can be older than it. None of these are positive things.

Some scientists disrespect soils, too. And yet, there has been no way to quantitatively account for the effect of different types of soil across broad regions. Instead, scientists often assign a fixed value for soils in calculating regional or global estimates.

Gene Kelly grew tired of seeing the soil treated like, well . . . dirt. So, he and his colleagues in the Department of Soil and Crop Sciences devised methods for identifying and quantifying soil. In doing so, these researchers have become spokespersons for the soil in the global climate change arena.

“Soil is a vital resource here in Colorado and across the globe, and it bothered me that it was being overlooked by other scientists,” says Kelly. “As the science of making regional and global projections became more quantitative, the soil science community needed to reconsider the way we studied the soils within natural and agricultural ecosystems.”

Integrating chemistry, physics, biology, geology, ecology, and anthropology, Colorado State’s soils team focuses on how soils affect and at the same time reflect the environment. Kelly says that other researchers need to understand this dynamic process to comprehend soil’s functioning in the ecosystem.

For example, the amount of carbon stored in the soil has emerged as a key factor in making local and regional climate change projections. To determine how and to what degree soil stores carbon in Colorado’s various ecosystems, Kelly and his students studied carbon storage, CO₂ fluxes, water storage, and water fluxes from alpine to grassland environments. The patterns they uncovered soon will be used in global climate change models.

Kelly’s lab also creates digital maps showing regional landscape patterns of soil processes and properties. These maps are in high demand throughout Colorado and the Great Plains. For example, real estate developers want maps of soil textures in areas on which they might want to build; land-use planners need maps of soil variations to create management strategies for different resources; and the agricultural industry benefits from knowing how soil properties have changed over time as a result of different management schemes.

In addition to studying contemporary soil processes, Kelly probes the soil to unearth prehistoric information as well. He is currently a lead principal investigator along with Indy Burke (Forest Service) and Jack Morgan (USDA-ARS) for Colorado State University’s Shortgrass Steppe Long Term Ecological Research Project, which is funded by the National Science Foundation with additional support from the Colorado State University Agricultural Experiment Station.

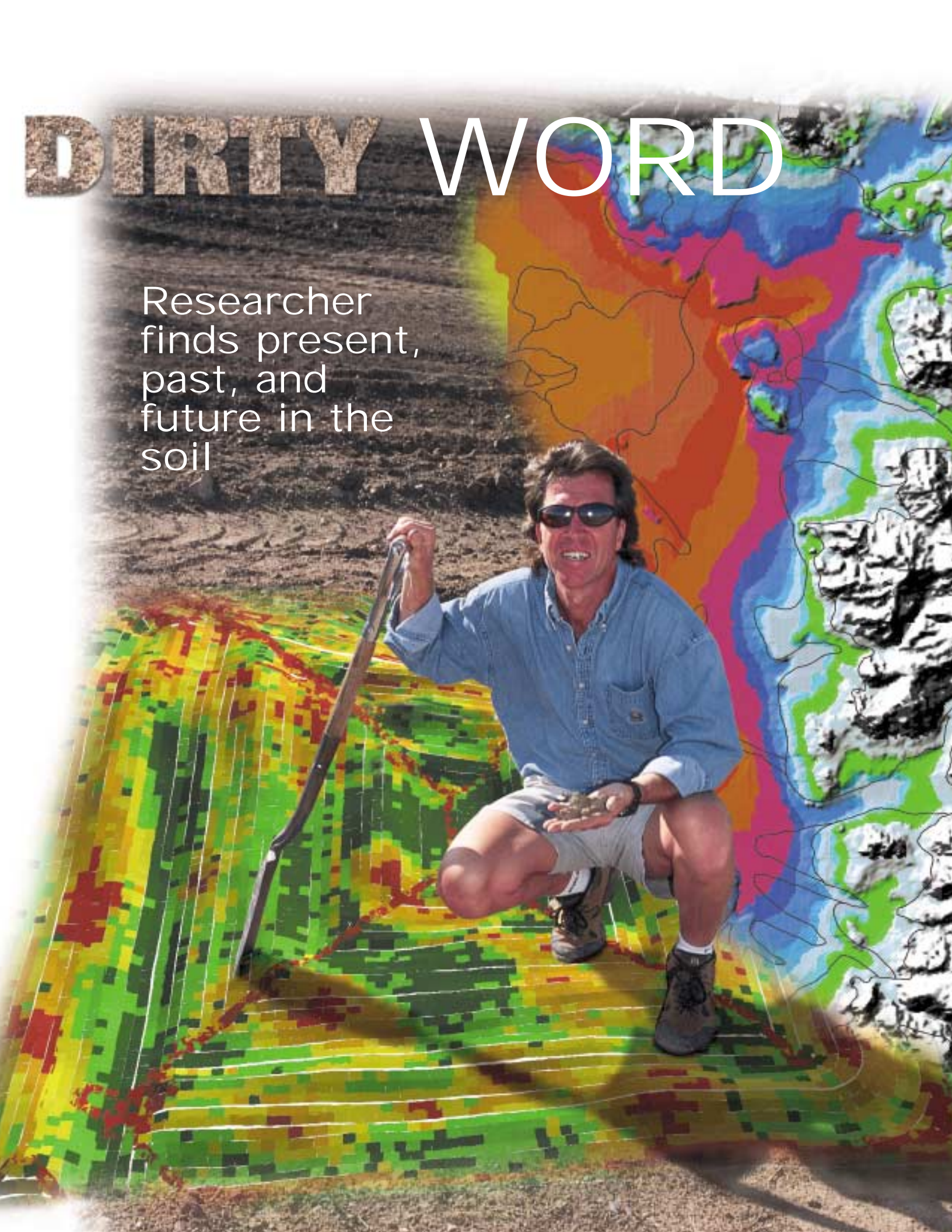
Kelly’s role in the project is to examine properties of soils to determine what the vegetative communities have looked like in eastern Colorado’s Great Plains over the past 100,000 years. When a plant grows, it leaves a “fingerprint” of organic materials and minerals in the soil. Using this fingerprint to identify the presence of different plants, Kelly can reconstruct climatic and environmental conditions that existed in the past.

“Based on these biological proxies, our initial results suggest warmer and drier conditions were present 6,000 years ago,” he says.

With current concerns about worldwide climate changes, Kelly hopes that understanding the past will help in figuring out what the future might hold. You might even say that the key to understanding the future is buried in the soil.

DIRTY WORD

Researcher
finds present,
past, and
future in the
soil



PRIME CUTS

Cattle ranchers work cooperatively to get a bigger cut of the profits

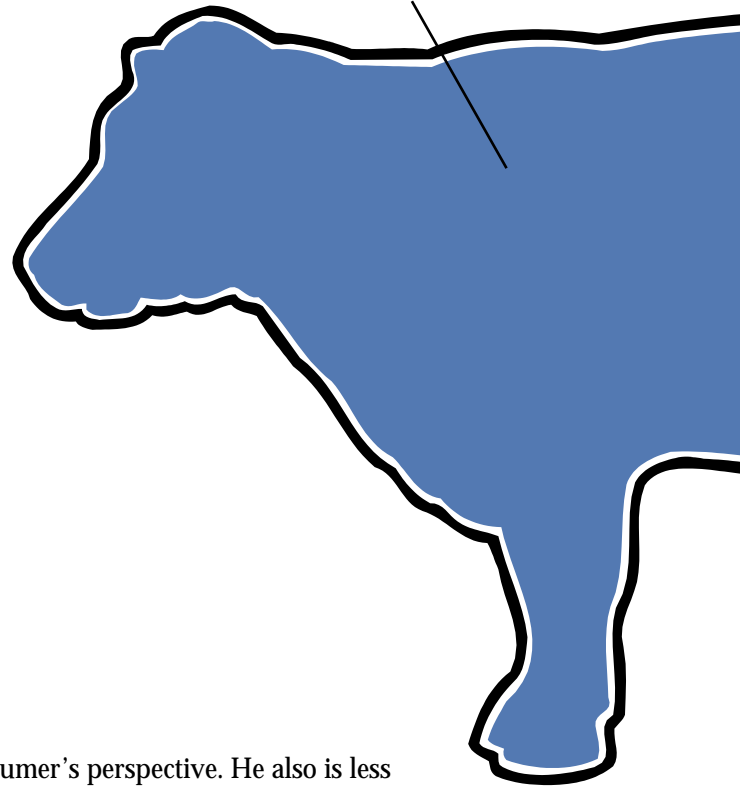
When we think of the Western cattle industry, we typically think of rugged individuals – cowboys riding alone and cattle ranchers relying on

their own strength and resourcefulness to earn a living from the land. That independence resonates within all of us; it's the West's version of the American dream.

Sadly, it's a dream that has been slowly disappearing for the last quarter of a century as independent ranchers get squeezed out by shrinking profits and rising costs. Ironically, in a recent survey, Colorado State University animal sciences Professor Jack Whittier has revealed that the best way for cattle ranchers to retain economic independence may be by simply learning to work more cooperatively with others.

It used to be that independent ranchers sold their calves to middlemen, who owned them for a short time before selling them to feedlots. The feedlots sold the animals to meat packers and so on down the line until retailers sold the final cuts of meat to consumers. The downside to this arrangement is that a rancher who sells his calves at weaning time rarely receives feedback about the quality of the final meat products from the

Cow/Calf Producers 59%



consumer's perspective. He also is less likely to receive greater rewards for producing better beef.

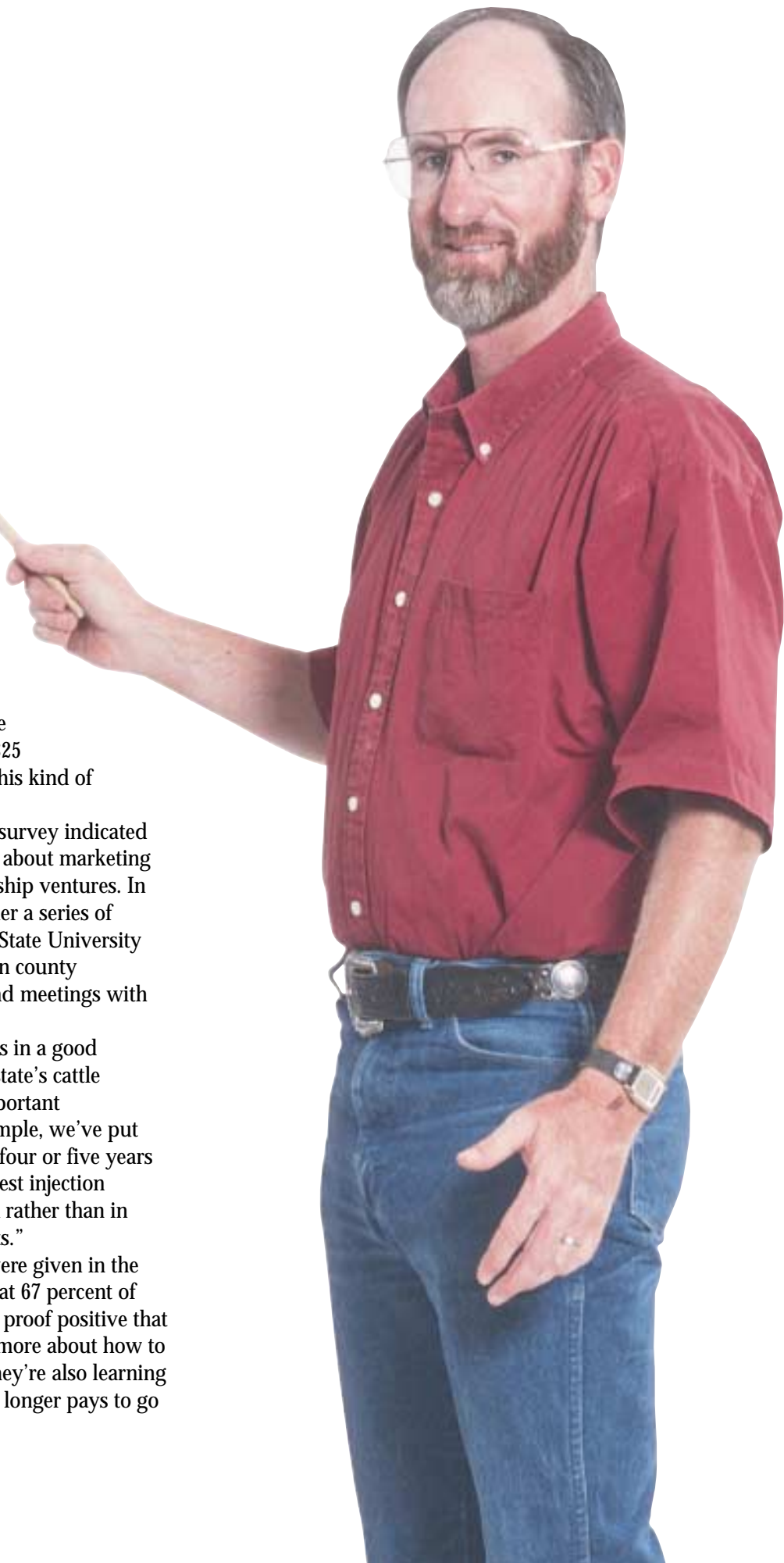
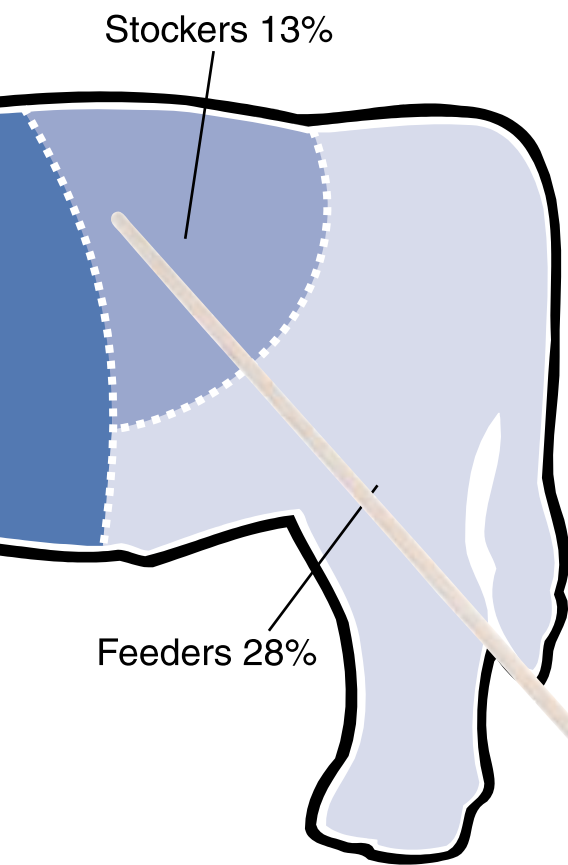
Whittier and his colleagues, Professor Dana Hoag in the Department of Agricultural and Resource Economics and D.E. Mount, graduate research assistant in the Department of Animal Sciences, surveyed 450 Colorado cow-calf producers about production systems and practices. The survey showed that more producers today maintain at least partial ownership of calves after they leave the ranch.

"We're seeing more ranchers contracting with someone to put cattle in a feedlot to develop them, and we're finding more retained and joint ownership ventures," Whittier says.

Here's how it works: A consortium of ranchers and feedlot operators put together management guidelines and specifications for breed composition and vaccination programs. The consortium then rewards those ranchers who adhere to the requirements through outright purchase or profit sharing.

"This is a fairly significant trend because it encourages more responsibility," Whittier says. "If a rancher has good cattle, and they perform well in the feedlot, the rancher benefits. He also has the opportunity to get feedback on the quality of his operation."

It's no secret that American consumers are becoming more concerned about the quality and safety of their food. "Consumers are willing to pay a premium for knowing that their meat comes from cattle that were



properly vaccinated,” explains Whittier. “And retailers are more willing to pass the rewards back to the producers. Ranchers could get up to \$25 more per head if they’re involved in this kind of marketing plan.”

The ranchers participating in the survey indicated they would like to be better informed about marketing opportunities such as retained ownership ventures. In response, Whittier plans to put together a series of informational materials for Colorado State University Cooperative Extension agents to use in county newsletters, community programs, and meetings with producers.

Whittier believes Colorado State is in a good position to lead this campaign. “The state’s cattle industry sees the University as an important educational entity,” he says. “For example, we’ve put forth tremendous effort over the past four or five years to educate beef producers about the best injection methods, such as injecting in the neck rather than in areas that produce more premium cuts.”

In 1993, 14 percent of injections were given in the neck. Whittier’s 1999 survey found that 67 percent of injections are now given in the neck – proof positive that cattle producers are open to learning more about how to increase the value of their product. They’re also learning that to win in the cattle industry, it no longer pays to go it alone.

Agricultural Research Development and Education Center

A new livestock facility at Colorado State University puts the university in a class with only a handful of other universities. The facility at

the Agricultural Research Development and Education Center, ARDEC, offers the benefit of a more spacious, state-of-the-art facility than what the university's previous facility, Rigden Farm, offered.

"The facility will be a major attraction for students who intend to study animal sciences and livestock, and it gives faculty the opportunity to teach in a new, state-of-the-art facility," said Steve LeValley, Colorado State Cooperative Extension specialist and the faculty representative for the facility's construction.

The new facility, which will be used by the Agricultural Experiment Station, triples the acreage available for pasture and crops to the University. The facility is on 700 acres just off of Interstate 25.

Although the first 280 acres were purchased in 1978, it wasn't until 1992 that the first phase of the project, the move of the plant sciences program, took place. The \$3 million plant science facility includes an office, conference room, and machine shop, with research plots to study irrigation, plant nutrition, pest control, and plant improvement of wheat, dry beans, and other crops. The \$8.4 million second phase, the animal sciences component, includes centralized animal handling facilities, a beef feedlot and nutrition unit, sheep research and teaching facilities, a calving and calf-care facility, self-contained swine units, irrigated pasture, crop land, and the new Education and Outreach center.

"The conference center allows us to expand teaching and outreach programs," said LeValley. In addition to a 300-seat arena, the Education and Outreach Center has classroom seating for 60 and a

12-seat conference room. It has capabilities for live animal evaluation and is equipped with catering facilities and audio-visual equipment.

The livestock handling facilities were designed by Temple Grandin, a Colorado State Animal Sciences professor internationally known for her efficient and humane animal handling designs. "The pens are designed to handle livestock with the least amount of stress in an efficient manner, with the least amount of manpower. They will demonstrate to our students the way to move livestock most effectively," said LeValley.

The number of single-animal pens for beef feedlot research has been increased from 15 to 48, and there are 50 ten-head pens for feedlot research. ARDEC also includes a new intensive ruminant nutrition research building, which will consolidate some of the projects currently conducted at the metabolic lab.

Two hundred acres at the new location are irrigated with a center-pivot sprinkler. The land will be used for cattle and sheep pasture. Other crop land at ARDEC will be used to grow corn and hay to feed the livestock and will allow the facility to be self-sufficient. "We've formed a unique coalition with the plant science unit to raise the crops," said LeValley.

Faculty are excited about the completion of the ARDEC facility and the potential it holds for livestock and crop research at Colorado State University.

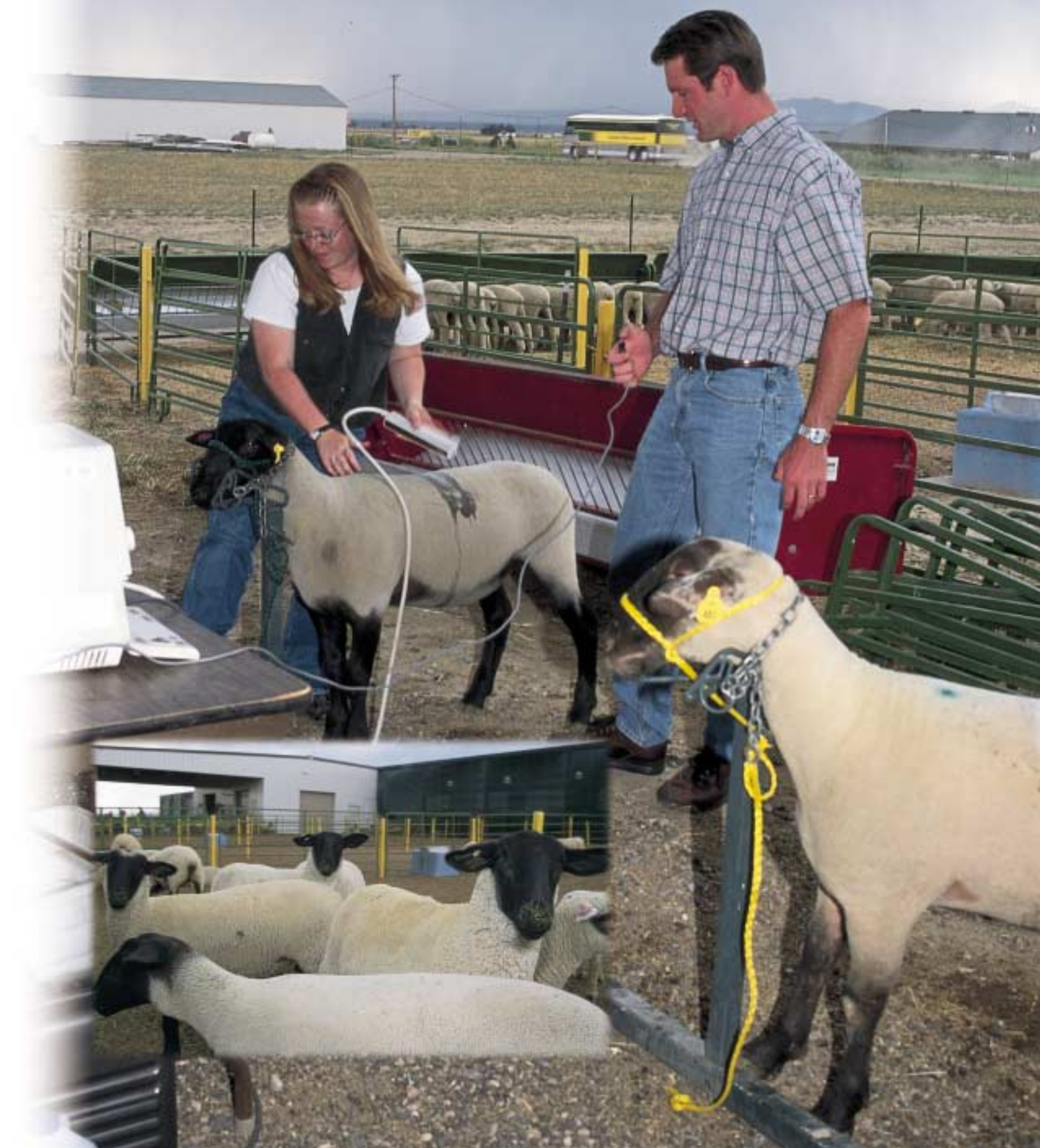
"Everybody is certainly excited to use this facility for student education, research, and outreach," said LeValley. The center, along with the rest of the facility, is already being put to use. It was featured in the ARDEC open house in September.

Opposite page: Meat Science graduate students Emily McClure and Michael Genho do an ultrasound on a ewe.

Right: A young girl gets to feel the texture of a tomato horn worm at the ARDEC open house September 8, 2000.



ARDEC



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Colorado State University Colleges and Departments

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Department of Animal Sciences
Department of Bioagricultural Sciences and Pest Management
Department of Horticulture and Landscape Architecture
Department of Soil and Crop Sciences

College of Applied Human Sciences

Department of Design, Merchandising, and Consumer Science
Department of Food Science and Human Nutrition
Department of Health and Exercise Science
Department of Human Development and Family Studies

College of Engineering

Department of Atmospheric Science
Department of Chemical and Bioresource Engineering
Department of Civil Engineering

College of Liberal Arts

Department of Sociology

College of Natural Resources

Department of Earth Resources
Department of Forest Sciences
Department of Rangeland Ecosystem Science
Natural Resource Ecology Laboratory (NREL)

College of Natural Sciences

Department of Biology
Department of Chemistry
Department of Statistics

College of Veterinary Medicine and Biomedical Sciences

Department of Anatomy and Neurobiology
Department of Clinical Sciences
Department of Environmental Health
Department of Microbiology
Department of Pathology
Department of Physiology
Department of Radiological Health Sciences

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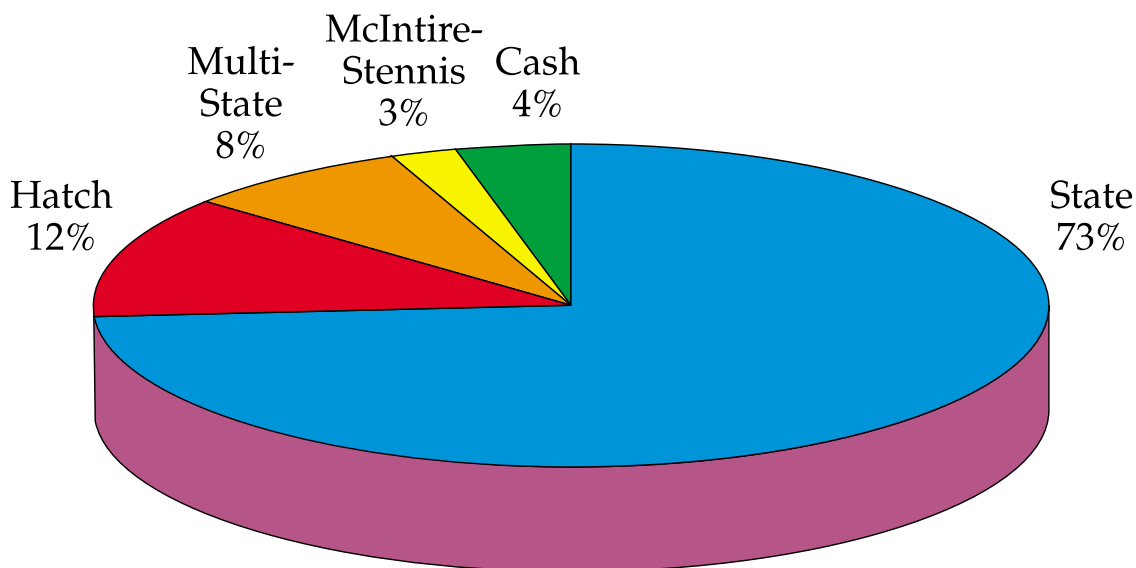
Colorado Agricultural Experiment Station Funding for Fiscal Year 2000-2001

The Agricultural Experiment Station at Colorado State University is funded by appropriations from the Colorado Legislature through the Colorado Commission on Higher Education, appropriations from the federal government through the United States Department of Agriculture, and from self-generated income through the sale of commodities. The relative amount of each funding source is shown in the chart.

- State – funds appropriated by the Colorado legislature and allocated to Colorado State University by the Commission on Higher Education
- Hatch – funds appropriated by the federal government to each land-grant university for support of a base research program in agriculture and natural resources. These funds were authorized by the Hatch Act of 1887, as amended by the Agricultural Research, Education and Extension Reform Act of 1998 and administered by the Cooperative States Research, Education, and Extension Service of the United States Department of Agriculture. The funds are prorated to each state based on a formula that includes several factors such as rural population and number of farms.

- Multi-state research – a portion of the Hatch funds are mandated by Congress to be applied to research problems that are regional in nature and involve the efforts of several states. Funds are administered the same as Hatch funds.
- McIntire-Stennis – funds appropriated by the federal government to support research in forestry and forest resources. Funds are administered the same as Hatch funds.
- Cash – funds originating from the sale of goods and services associated with Agricultural Experiment Station programs. Commodities sold include crops and livestock, which are by-products of applied research programs conducted at research centers.

In addition to the above direct funding sources, scientists supported by the Agricultural Experiment Station are active in securing contract and grant funding from numerous private sources, as well as state and federal agencies. In the 1999-2000 fiscal year, contract and grant funding from these external sources contributed in excess of \$20,000,000 of support to our research programs.



Total Budget: \$12,506,290

