C MAGAZINE

Fertilizer's Future

What's down the road for crop nutrients?

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CONTENTS

FALL 2023

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Fertilizer's Efficient Future

6

Technology and management advances improve nutrient use and sustainability.

FEATURES

DEPARTMENTS

ON THE COVER: Eric Steigerwalt, left, an agronomist with Co-Alliance Cooperative, discusses 2024 fertilizer needs with Randy Bales, center, and his son, Brad Bales, on their farm near Lewisville, Ind. Co-Alliance supplies crop nutrients and technical expertise to maximize return on the Bales operation's input investments.

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Connecting grain from our farmer-owners to customers around the world

At CHS, we play a vital role in connecting growers to food companies and consumers around the world. Through a network of cooperatives and farmer-owners, we source grain for domestic and international processing, livestock production and renewable fuels manufacturing. Our experts participate in global commodity markets, monitor local crop conditions and share market intelligence daily to help customers make informed buying and selling decisions.

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CHS®

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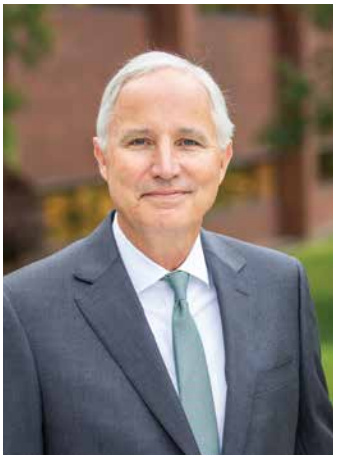


Jay Debertin, president and CEO, CHS

Connecting on Solutions

As we consider how crop inputs will be used in the future, we know the answer to the riddle: We'll need to use less fertilizer, less water and less energy to make more food for a hungrier world.

The hard part is knowing how to get to that answer.

At CHS, we're addressing the challenge from many directions, with the focus on using fertilizer more efficiently while getting more yield from every acre.

We are applying seed advances that help crops produce reliable results despite challenging conditions.

We continue to bolster our crop nutrient supply chain by strengthening our global connections with fertilizer manufacturers, adding capacity to our import facility in Galveston, Texas, and ensuring we have a ready domestic supply of nitrogen fertilizers through our long-term investment in CF Nitrogen.

Our agronomy experts are working hand-in-hand with cooperative agronomists and growers to test and implement new methods for precision-feeding nutrients to developing crops throughout the season. And our enhanced-efficiency fertilizer products help ensure nutrients are ready and waiting for crops to use as they grow.

While it's easy to see how strategic fertilizer use boosts return on investment by controlling input costs per bushel, we're also looking to reduce impact on the environment. Our enhanced-efficiency products help there, too, by holding nutrients in soil until they're needed by crops. And CHS is prepared to distribute the low-carbon nitrogen CF Industries is developing, which will reduce greenhouse gas emissions during fertilizer manufacturing.

Those are just a few ways we are leveraging our supply chain strength and the collective expertise within the cooperative system to provide value for CHS owners through more sustainable thinking — and action — related to fertilizer use.

I look forward to finding new ways to solve this critical riddle as we work together to create connections that empower agriculture.

Jay D. Debertin

Have a question or feedback for the CHS management team? Get in touch with us at feedback@chsinc.com.

Fertilizer's

Efficient Future

New approaches and new technology are key to improving nutrient use and sustainability.

By Matthew Wilde

Embracing the 4Rs of fertilizer — right source, right rate, right place and right time — helped Randy Bales increase yields and revenue on his Indiana farm while protecting the environment. Other factors contributed, too, such as adopting 20-inch rows and planting cover crops, but he's confident that enhanced nutrient management is the key to long-term success.

"Losing fertilizer doesn't help your bottom line and it hurts the environment," says Bales, who farms with his son, Brad, near Lewisville. "The future of fertilizer is improved efficiency."

Farmers couldn't produce enough crops to feed a growing world without nitrogen (N), phosphorus (P), potassium (K) and micronutrients. Replenishing the >

Eric Steigerwalt, center, a Co-Alliance Cooperative agronomist, discusses fertilizer strategies with Randy, right, and Brad Bales of Lewisville, Ind.

Fertilizer efficiency continues to improve due to research, technology and evolving application methods.

> soil after each cropping season is a must. But fertilizer production and use doesn't come without environmental risks.

Farmers, agronomists and industry leaders say understanding and leveraging new technologies and following 4R principles will refine how fertilizer is made, applied and used by plants to make crop production more sustainable and productive in the future.

Roger Baker, who leads crop nutrient supply, trading and risk management for CHS, says nutrient use is starting to decline as adoption of enhanced-efficiency fertilizers and precision agriculture tools increases and application rules are implemented. In 2021, U.S. corn farmers used 21.2 billion pounds of N, P, K and sulfur (S) compared to 21.5 billion pounds in 2018, according to the latest U.S. Department of Agriculture (USDA) data. The same nutrients used in wheat production totaled 4 billion pounds in 2022 compared to 4.4 billion pounds in 2019.

"Continuous improvement of nutrient efficiency from a cost and environmental standpoint will occur," Baker says. "Some of that change will lie in the hands of regulators dictating how fertilizer is used, some with sustainability goals of businesses and some with better agronomic and management practices."

Volatility will also shape the fertilizer industry going forward, says Corey Rosenbusch, president and CEO of The Fertilizer Institute, based in Arlington, Va. Many factors contributed to tight supplies and record prices in 2022 — anhydrous ammonia averaged $1,635 per ton in June 2022, according to USDA data, compared to the five-year average of less than $780 per ton — led by the ongoing war between Russia and Ukraine, lingering supply chain disruptions due to the COVID-19 pandemic and high natural gas prices.

"Combining that [volatility] with pretty good crop prices allowed fertilizer innovation to flourish," Rosenbusch continues. "It spurred product development in biologicals, coatings, inhibitors and slow-release technologies. High prices also caused farmers

to be more willing to experiment and be critical of fertilizer use to maximize inputs and yields."

Focus on Placement

Bales farms nearly 1,800 acres of mostly corn and soybeans, mixing in about 40 acres of winter wheat or oats each year to diversify his crop rotation. To operate a sustainable farm, both economically and environmentally, Bales closely monitors agronomic research and follows 4R principles. He says one of his best decisions was to abandon planting crops in 30-inch rows in 2017 and switch to 20-inch rows and an enhanced management system based on research conducted by Fred Below, a University of Illinois crop physiologist.

"We're going to have to increase yields while using less fertilizer," Below says. "I'm convinced that better placement is the key."

Below's research over five years of testing shows a combination of banding granular fertilizer (N, P, S and zinc) under corn rows for easy access by roots, split-applying 240 pounds of N preplant and in-season, a foliar fungicide treatment and 20-inch rows with seeding rates of 40,000-plus plants per acre averaged 264 bushels per acre. Corn in 30-inch rows at 32,000 plants per acre with no fungicide treatment and 180 pounds of N applied preplant and P and K broadcast-applied based on soil tests averaged only 213 bushels per acre — a 19% drop.

By mostly following Below's management and adding soil health practices like planting cover crops on every acre to build organic matter, Bales was able to significantly increase corn production and net revenue. Average yields have increased from less than 200 to 225 bushels per acre, 18% better than the county average, Bales says.

Discussions about improving fertilizer efficiency regularly occur between, from left, Indiana farmers Brad and Randy Bales and their agronomist, Eric Steigerwalt with Co-Alliance Cooperative.

Better fertilizer placement and timing — banding and split N applications — played a big role. "In our checks, if we didn't band fertilizer, corn would be one growth stage behind corn in the areas where we banded," he says.

Bales works with Eric Steigerwalt, an agronomist with Co-Alliance Cooperative based in Indianapolis, Ind. Together, they come up with annual cropping plans, which include use of enhanced-efficiency fertilizers.

"At Co-Alliance, our goal is to provide farmers with everything they need in a timely manner to practice the 4Rs appropriately," Steigerwalt says. "The Baleses have done a great job implementing the 4Rs."

Bales and Steigerwalt were selected as 4R Advocates in 2023 by The Fertilizer Institute. The organization annually honors three farmers and their fertilizer retail partners for their commitment to implementing fertilizer management practices that embody 4R nutrient stewardship.

Improvement to Come

As precision ag technology, soil testing and data collection continue to improve, Co-Alliance soil and crop fertility experts say better nutrient management and use will follow. The cooperative serves farmers in Indiana, Ohio and Michigan.

Farmers have used yield data and GPS when taking soil samples to apply fertilizer at variable rates for decades, says Noah Freeman, Co-Alliance senior director of agronomy technology. Mining data using analytics, computer modeling and machine learning is improving by leaps and bounds that will improve fertilizer efficiency.

"In the future, we will have a better understanding of spatial variability in the soil to put fertilizer where it really needs to >

"We're dedicated to creating a better environment for future generations by providing affordable green fertilizer."
— Shuang Gu

GREEN TEAM

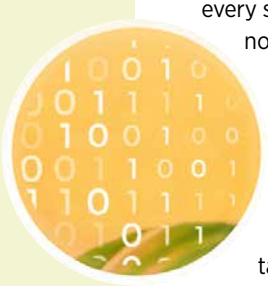
Wichita State University and Iowa State University researchers are teaming up to develop a system powered by renewable energy that reduces greenhouse gas emissions during fertilizer production.

The project will design materials, processes and reactors for the electrochemical capture and conversion of waste nitrogen and carbon dioxide to make fertilizer known as "green urea." Scientists will also model the nitrogen life cycle in crops, develop nitrogen sensors for crops and educate farmers about the new fertilizer.

The National Science Foundation is supporting the project with a four-year, $4 million grant. Researchers Shuang Gu at Wichita State and Wenzhen Li at Iowa State lead the effort.

Gu says fertilizer will always be essential for crop production, but producing more climate-friendly nutrients will enable a shift toward more sustainable agriculture.

"We're dedicated to creating a better environment for future generations by providing affordable green fertilizer."



> be," he says. "As computation power continues to improve, we're able to better determine limiting yield factors to write better variable-rate fertilizer prescriptions."

In-season tissue testing and aerial imagery will continue to grow in popularity, Freeman adds, and pairing data and analytics will yield vital information to make better in-season and future nutrient decisions. Already, airplanes and drones with multispectral sensors — RGB (red, blue, green), chlorophyll, thermal and NDVI (normalized difference vegetation index), for example — can identify distressed plants, often before the human eye can detect problems. Co-Alliance hires 40 college interns each summer to serve as crop scouts and most now use drones for scouting.

More emphasis will be placed on reducing fertilizer loss and carbon sequestration through financial incentives to farmers, says Caleb Smith, Co-Alliance sustainability director. He helps producers sign up for sustainability programs that pay them to use conservation practices such as cover crops and no-till. He says farmers earn $30 to $40 per acre on average.

"If they want to get paid for practices that improve fertilizer efficiency and nutrient stewardship, we take care of every step in the process at no charge," Smith says. "We anticipate more companies outside agriculture will rely on farmers to meet their supply chain decarbonization targets. I think we're on the forefront of connecting growers to these opportunities."

Enhanced Efficiency

With increased economic and environmental pressures, CHS fertilizer experts say growers must maximize their fertilizer investment by minimizing nutrient loss. Jake Niederer, senior director of phosphate risk management at CHS, says the cooperative will continue to develop and improve enhanced-efficiency fertilizers. These products include controlled-release fertilizer, ammonia volatilization inhibitors and nitrification inhibitors.

> "In the future, we will have a better understanding of spatial variability in the soil to put fertilizer where it really needs to be."
> — *Noah Freeman*

"We need to continue to embrace those products and bring them to market," he says. "We always ask ourselves, 'Can we do more with less?' That's the essence of conservation and good community stewardship."

Leading-edge efficiency fertilizer products are growing in popularity.

Trivar® is the first fertilizer additive specifically designed for broadcast phosphorus applications. It increases the availability of phosphorus and other key nutrients to plants. Trivar includes Levesol®, which is an advanced, patented nutrient-efficiency solution with a unique, scientifically proven chelate that makes phosphorus, zinc and other micronutrients more available to plants. Levesol solutions are available for dry and liquid fertilizers.

N-Edge® nitrogen stabilizers protect fertilizer investment. N-Edge Pro is applied to both above-ground and below-ground applications of urea and UAN to protect against leaching and denitrification.

"There's always ongoing work to improve our products and develop new ones," says Todd Mackendanz, senior director of nitrogen risk management at CHS.

"We'll continue to partner with producers who are active in research and development to bring new products to light that will enhance fertilizer efficiency," Niederer adds.

Low-carbon N

Global efforts are underway to reduce carbon emissions. Many companies have sustainability goals, which may dictate future fertilizer production and use. CHS has partnered with CF Industries, one of the world's largest producers of fertilizer, to accelerate production and distribution of low-carbon nitrogen fertilizer to further sustainability efforts.

"Farmers also want to do their part to help the environment and be good stewards of the land," Baker says, noting low-carbon N is one way to meet sustainability goals.

CF Industries is investing in technology to sequester carbon and produce green ammonia, which is made using hydrogen from carbon-free sources, according to the company. CF Industries is constructing North America's

NEXT-GENERATION NITROGEN

The fertilizer and agriculture industries are under pressure to reduce their carbon footprint. A next-generation green ammonia plant being built at the University of Minnesota West Central Research and Outreach Center (WCROC) in Morris will help.

Traditional anhydrous ammonia production uses natural gas and contributes more than 1% of global greenhouse gases, says Mike Reese, WCROC director and green hydrogen and ammonia lead. The new plant uses clean, renewable energy to make fertilizer. Eventually, he believes regional green ammonia plants will dot the landscape, which would be a win for farmers and the planet.

"It's a matter of when, not if, facilities will start producing green ammonia. There's interest from farm groups, utilities, fertilizer companies and energy companies," Reese says. "If farmers use green sources of nitrogen fertilizer, it reduces fossil fuel use and pollution. It also reduces the carbon intensity of agricultural products such as ethanol, meat and eggs," which could increase their value.

Making the vision a reality requires economic feasibility. Ten years ago, scientists at WCROC developed what was then first-in-the-world technology using wind power to pull nitrogen from air and hydrogen from water to make 6 pounds of anhydrous ammonia per hour. The pilot project proved the technology works but needed to be scaled up to compete with plants churning out thousands of tons of anhydrous ammonia a day.

The new plant, funded by a $12.5 million U.S. Department of Energy grant, will use the center's existing 1.65 megawatt wind turbine and 250 kilowatt solar farm to produce 15 times more fertilizer than the first facility, or 1 metric ton per day. It's scheduled to come online in September 2024 and undergo several years of testing. The project is part of a process to scale up production of green anhydrous ammonia to at least 30,000 metric tons a year per plant, which Reese says is attainable.

A plant that size could produce green anhydrous ammonia for $600 to $800 per ton, he says, and federal pollution-reduction tax incentives could help reduce the cost.

Researchers at the University of Minnesota are working to scale up production of green ammonia fertilizer using wind and solar power. (Photo: University of Minnesota)

first commercial-scale green ammonia production site at its Donaldsonville Complex in Louisiana. The project, expected to be complete at the end of 2023, will be able to produce up to 20,000 tons of green ammonia per year.

The fertilizer manufacturer is also constructing a carbon dioxide (CO_2) dehydration and compression facility to capture and store up to 2 million tons of CO_2 per year as early as 2025.

Smith of Co-Alliance envisions a day when commodity premiums, commodity prices or both will be linked to carbon intensity of crop production. He says green fertilizer products — ammonia and potash — could play a pivotal role in helping farmers maximize revenue potential.

Not So Risky

Strengthening the fertilizer supply chain and providing price risk management tools are a priority for CHS and the cooperative system, says Baker.

A $30 million investment in the CHS deep-water port at Galveston, Texas, will improve the heart of the cooperative's fertilizer import and distribution system. More than 450,000 tons of urea and 120,000 tons of phosphate are imported through the terminal each year, then shipped to CHS and cooperative warehouses or hub plants, mostly by train.

Port improvements will increase ship unloading speed from 600 tons to 1,200 tons per hour and shrink the time it takes >

"We're going to have to increase yields while using less fertilizer. I'm convinced that better placement is the key."
— Fred Below

CHS is investing $30 million to improve fertilizer unloading and loading capabilities at its deep-water terminal at the port of Galveston.

> to load railcars, each carrying up to 96 tons of fertilizer.

The investment is geared to ensure farmers get the nutrients they need when they need them.

"Galveston is an integral asset in our supply chain," Baker says. Another key component is strategically placed hub plants, which each hold about 10,000 tons of fertilizer and distribute crop nutrients to cooperatives and retailers.

Baker says dry fertilizer storage capacity at CHS hub plants is roughly 1 million tons and storage capacity at member cooperative hub plants is another 1.5 million tons. "To fill that storage, we need to secure logistics for the future. That's one reason why we are investing in Galveston — to secure import availability for CHS and our owners."

Co-Alliance Cooperative is strengthening its own fertilizer supply chain by increasing dry storage capacity, automating liquid loadout facilities so farmers can get products whenever they need them and refining fertilizer purchasing. The co-op recently invested $15 million in its Mt. Summit Ag Center in eastern Indiana, which includes a new dry fertilizer hub that holds 26,000 tons.

"We strive to provide the best prices and product availability. If our fertilizer hubs aren't full in the middle of November when we're applying, it doesn't do anyone any good," Freeman says. "Investments made in facilities and logistics help farmers make the most of their fertilizer investment." ■

LEARN MORE: Watch a video about the next phase for fertilizer at chsinc.com/c.

"Losing fertilizer doesn't help your bottom line and it hurts the environment. The future of fertilizer is improved efficiency."
— Randy Bales

sunny side up

From breeding to processing, CHS has sunflower seeds covered.

By Amy Sitze

Kids digging into their school lunches, shoppers at a major U.S. grocery chain and consumers in Greece eating a favorite tasty snack have something in common: They're all enjoying sunflower seeds grown by CHS farmer-owners and processed at CHS facilities.

In a typical year, CHS farmer-owners grow about 40,000 to 50,000 acres of confection seeds — the edible kind sold as snacks or ingredients in the shell or as kernels — as well as about 5,000 acres of conoil seeds, a cross between oil seeds (which are used for sunflower oil and birdseed) and confection seeds.

Potential Profits

Sunflowers can be challenging to grow, but the crop can also be profitable, says Craig Hertsgaard, a fifth-generation farmer in Kindred, N.D., who's been rotating sunflowers with corn, soybeans and sugar beets for about 10 years.

"Because sunflowers are a minor crop, there hasn't been much research in developing products for weed control and disease control," he says. "So we have to develop a system for planting them at a time >

After sunflower kernels go through an oil fryer, they're dried on a cooling belt.

80%
sold in the U.S.

20%
exported
mainly to Spain and Greece

85%
sold in-shell for roasting and flavoring

15%
sold as kernels with shells removed

> when we can control weeds early and during the growing season."

Hertsgaard says he appreciates the quality and consistency of CHS Royal Hybrid® sunflower seed. "The varieties are well adapted to the soils we have in the Red River Valley," he says. "The equipment we use to plant sunflowers is very sensitive to seed quality and sizing, and CHS is able to produce a product that works well in our planting equipment."

CHS is the only major sunflower processor that maintains its own hybrid seed division, complete with nursery, greenhouse and laboratory facilities staffed by seed genetics experts. Those experts put thousands of hybrids through rigorous lab tests and field trials each year to select the most desirable characteristics based on customer input and market demand — for example, rich flavor, firm kernels, large size, unique shape, improved yields and high quality.

Sunflower seeds are not genetically modified, which is important when selling into European markets that ban GMO crops, says Devin Gaugler, origination manager and agronomist for the CHS sunflower business.

Gaugler says the farmers he supports appreciate having sunflowers in their rotation because the plants thrive in dry conditions. They also root deeply enough to recover nutrients that shallow-rooted crops like wheat and soybeans didn't use the previous year. "A sunflower will tap into that deep nutrient load," he says. "That gives you some cost savings."

Preparation and Processing

After Hertsgaard and other contracted farmers harvest and dry their sunflower seeds, they deliver them to the CHS processing facility in Grandin, N.D. There, the seeds are dried, cleaned and sized. The largest seeds are generally sold as in-shell seeds, while medium-sized seeds are hulled for the kernel market and the smallest seeds are used in birdseed and pet food.

"CHS is able to produce a product that works well in our planting equipment."
— Craig Hertsgaard

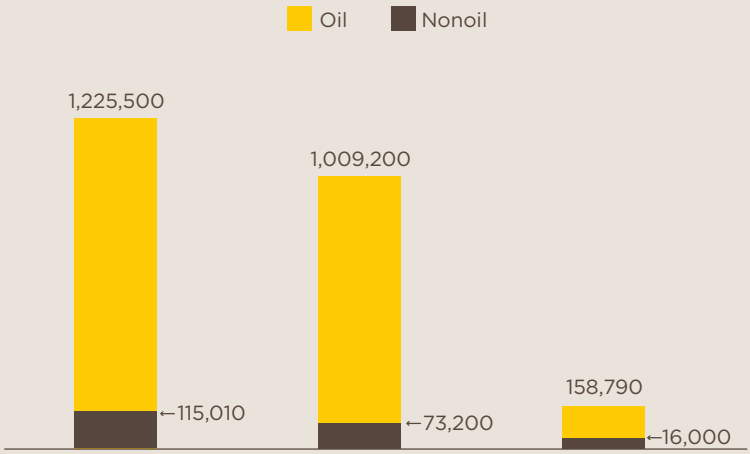
Once they're cleaned and sized, some sunflower seeds are sent straight to domestic and international customers who do their own processing, while others go to the CHS facility in Fargo, N.D., for pasteurization, oil roasting and dry roasting.

Dean Hjelden, who manages the Fargo plant, describes the facility's pasteurization process as "very state-of-the-art, very modern." Cocoa bean roasting equipment from Holland was modified specifically for the CHS sunflower processing plant.

"The equipment was designed for gentle handling," Hjelden

Top 3 Sunflower States, 2022

(production in 1,000 pounds)



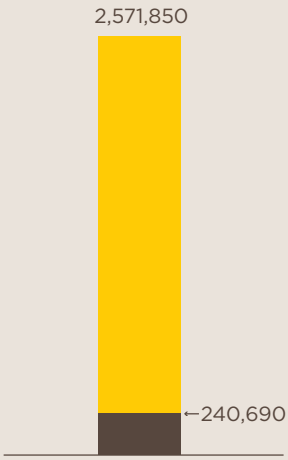
North Dakota
Total: 1,340,510

South Dakota
Total: 1,082,400

Minnesota
Total: 174,790

U.S. Total, 2022

(production in 1,000 pounds)



U.S. total
Total: 2,812,540

Source: USDA, 2023

Ben Paweh, who's been a production associate at the CHS Fargo, N.D., sunflower processing facility for three years, packages finished kernels to be shipped to a major grocery chain.

says. "It provides thorough pasteurization without compromising the texture, quality, color or taste of the sunflower seeds."

About 80% of the seeds are sold to domestic customers and 20% are exported — mainly to Spain and Greece. About 85% are sold in-shell for roasting and flavoring, while 15% are sold as kernels with the shells removed for snacks or as a food ingredient.

What makes CHS unique, says Gaugler, is attention to the product through the whole journey from breeding seeds to finding markets.

"We breed the seed, we produce the seed, we support farmers who grow it, we bring it in and we process it," he says. "Sometimes farmers are hesitant to do business with specialty crop processors because of the unpredictability of today's marketplace. At CHS, growers can be assured they have the backing and resources of the entire enterprise to help them do everything possible to grow a high-quality crop and maximize their returns." ■

LEARN MORE about sunflower contracting opportunities at chsinc.com/sunflower.

The next generation gets a bird's-eye view of corn harvest as Richard Stadheim, a southern Minnesota farmer, lets his grandsons take turns in the buddy seat.

Crop Cadet

Richard Stadheim remembers introducing his sons to the joys and challenges of corn and soybean harvest on their southern Minnesota farm. Now those boys have kids of their own, who vie for the opportunity to ride along in the combine with Grandpa or Dad.

There's something special about working as a family to take a crop from seed to harvest. Golden fall days make the final stage even more rewarding, despite the long hours and urgency to finish up before winter.

In another two or three decades, the youngest Stadheims will likely be sharing their love for agriculture with their own children, as the seasons roll on and they continue caring for their family's legacy.

— Cynthia Clanton

STEP BY

By Cynthia Clanton

A black-and-white river flows through the high plains of Colorado.

Calmly walking from loafing shed to milking parlor and back again three times every day, the 6,000 Holsteins at Quail Ridge Dairy southeast of Fort Morgan move at their own pace, quietly contributing their milk production talent while the dairy operation hums along.

It's all powered by cow-inspired planning and a team of 85 people who manage every detail of animal comfort, while maintaining a pleasant, rewarding work environment.

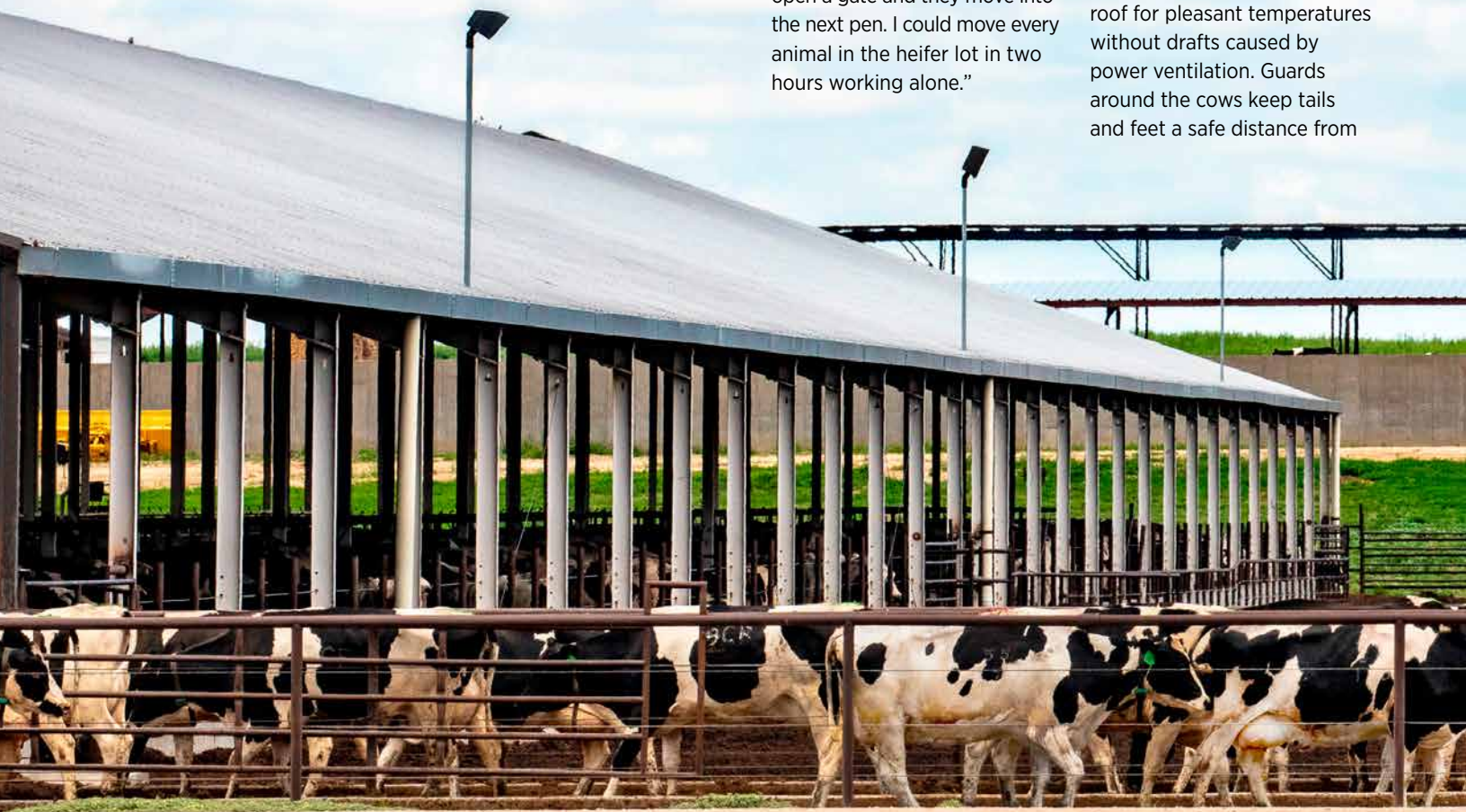
Comfort First

"I'm really into systems and I love efficiency," says Mary Kraft, who owns and manages Quail Ridge Dairy with her husband, Chris, and son, Stratton. "We are always thinking about animal behavior and how we can capitalize on it to make the animals comfortable."

The interconnected facility keeps labor to a minimum and avoids bottlenecks. "I can just open a gate and they move into the next pen. I could move every animal in the heifer lot in two hours working alone."

In the double-50 parallel milking parlor, Kraft leverages the herd instinct. "If cows can see each other, moving in a group and not too fast, they'll be more comfortable and will let down their milk faster. With 50 cows on a side, if two or three take an extra four or five minutes to milk, that slows down the whole barn."

Employee comfort is also top of mind. The milking parlor floors are heated to help them stay dry and a center ridge design keeps air flowing into the room and out through the roof for pleasant temperatures without drafts caused by power ventilation. Guards around the cows keep tails and feet a safe distance from



STEP

A cows-first approach helps this Colorado dairy move ahead.

the eight-person milking teams, while offering easy access for prep and milking tasks.

Every cow sports a transponder that collects data on milk production, breeding dates and more. A computerized system at each milking station lets milkers send an alert when a cow needs attention. After milking, those cows and others due for drying off are automatically diverted through a shuttle gate to a holding pen for reassignment to the dry cow group or the farm's hospital facility.

"That technology means we have a no-stress environment," says Kraft. "I don't want an environment where cows get injured because we're doing things too quickly or without thinking. And employees, who are busy with 12 other things, don't have to remember it all."

The steady stream of production data also helps her detect when a cow's milk output is lagging. "Every cow has a unique threshold based on past performance. I know how much milk she gave on every shift since she started milking. Milk per cow per day is what I'm looking for. If she's going to keep her spot, she needs to produce 10 gallons a day.

"We're all interested in how big our carbon footprint is — well, your footprint gets bigger when you have a cow that's not making the milk she should. She's using resources and not contributing."

Integrated System

The highly efficient setup means every cow is in and out of the milking parlor in about 10 minutes. "We want to get her back to a healthy, comfortable place where she can chew her cud, eat as much as she wants, have free-choice water and hang out with her buddies," says Kraft.

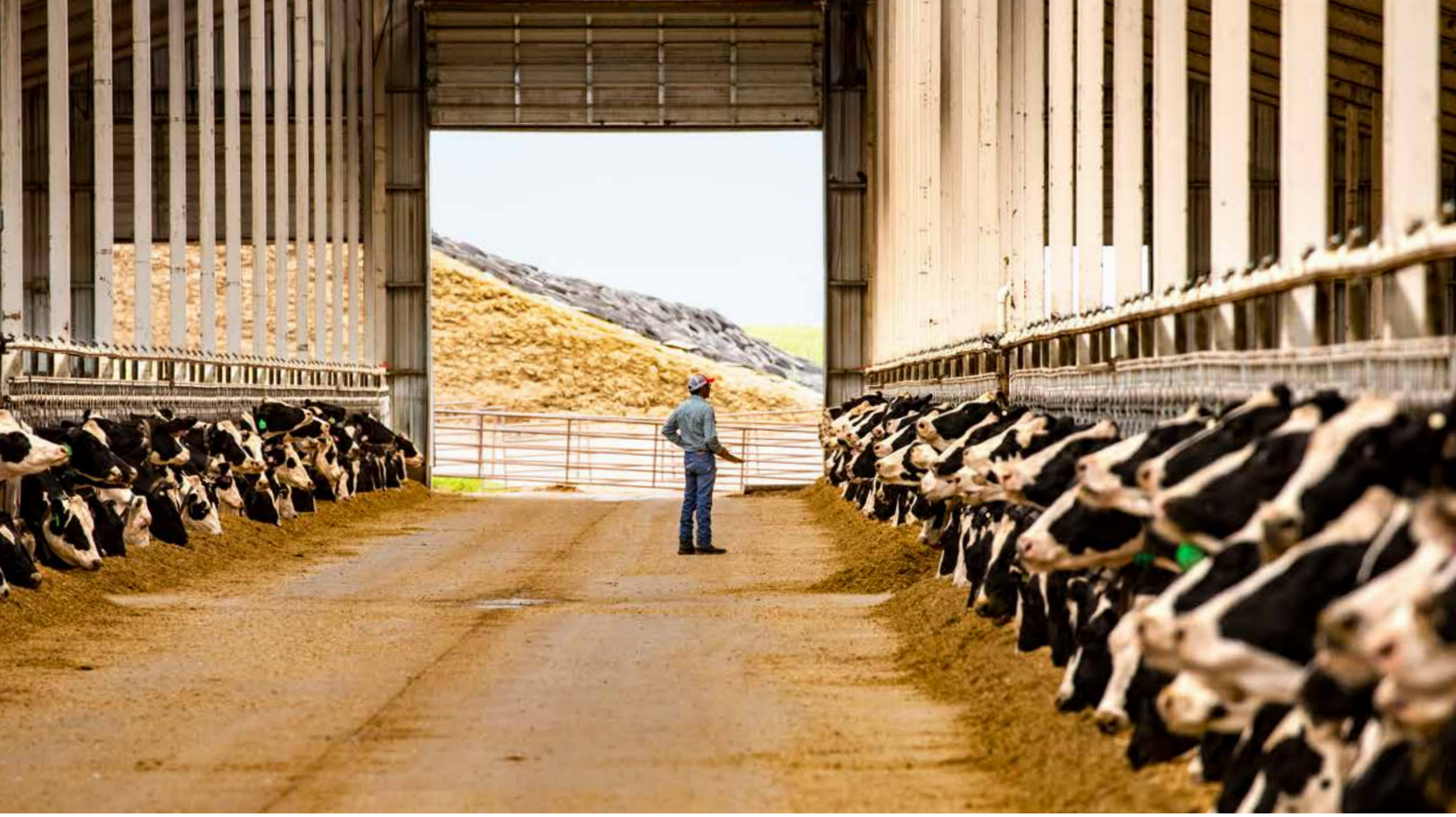
Most of the cows' time is spent in one of the farm's five airy freestall barns, each holding two groups of 450 cows. They have access to outside lots when fine weather beckons.

With constant movement to and from the milking parlor, the freestall barns are only empty for about 25 minutes at a time. While cows are away, workers tidy the beds and add feed. Every day at 4 a.m., the bunks are scraped clean and fresh feed is added.

The bedding is produced by the farm's on-site waste management system. An automatic scraper system cleans the freestall barn floors every 45 minutes while the cows are in place, moving so slowly that cows can step over the scraper without startling. A center gutter collects waste and directs it into a screw separator.

Wastewater is used to transport waste, with overflow sent to a lagoon until it's used to irrigate and fertilize the farm's 1,500 crop acres, which produce about one-third of its annual forage needs. Irrigation is essential >

The gentle flow of cows to and from the milking parlor keeps Quail Ridge Dairy running smoothly.



Employees use digital communications to alert managers to any cows that fail to walk up to the bunk to eat and need an evaluation.

"I totally believe in cooperatives. Together, we can do what we can't do individually."
— Mary Kraft

> in this arid region, which typically gets 15 inches of moisture per year, although the past year was an exception with 34 inches of snow, a soggy spring and the wettest June on record.

Waste solids are composted in windrows arrayed on a concrete pad. The rows are turned frequently to incorporate oxygen, accelerating the composting process.

"Composting takes six to eight weeks," says Kraft. "The compost reaches about 140 degrees Fahrenheit, which kills harmful microorganisms. We end up with about one-third of the original volume and the compost makes a soft bed that molds to the cows."

The farm has experimented with methane digestion, but hasn't made it part of the waste management system because while methane is produced, the digester can't produce sterile, dry bedding. "The solids coming out of the digester are wet, so we would have to compost them again," she explains.

Attention to Detail

Animals that need special care or are due to calve hitch a ride on a transport that shuttles between the main dairy and a smaller drylot dairy about a mile down the road. The smaller site includes a milking parlor for 1,500 cows and handles all maternity and veterinary functions.

Employees work there in shifts around the clock, processing 20 to 30 newborn calves per day, helping cows recover from calving and treating any illnesses or injuries. They handle standard veterinary procedures with oversight by a veterinarian.

"We are always looking to prevent problems and we vaccinate like crazy," says Kraft. "We pay attention to nutrition to avoid problems due to diarrhea, displaced abomasums and things like that." Monitoring urine pH on dry cows helps determine when ration changes are needed.

Veterinary support is focused on analyzing data to spot problem areas and improve production. "I want my veterinarian to help us figure out if we are producing 1% less milk than we should or have 1% more lame cows than we should."

Rations are based on flaked corn and a revolving list of byproducts including wheat middlings, DDGS (distillers dried grains with solubles), canola meal and soy hulls. A liquid supplement is used and wet brewers grain helps bind the dry ingredients to reduce wind loss and add palatability.

Agfinity cooperative, based in Loveland, Colo., provides high-energy specialty ingredients that support rumen function and boost cow metabolism, plus provide a feed grain mix for calves.

"The specialty fats we feed make a difference in how the cow metabolizes ingredients," says Kraft. "We watch body condition scores and pair that with production. That tells me

how well she's utilizing feed. If we're feeding her to make 100 pounds of milk and she's only putting in 80 pounds, she's not using nutrients properly."

Organic Growth

The drylot dairy site was where the Krafts started farming in 1988 with 100 cows, old buildings and worn-out fences. "We're very organic in our growth, so everything we did here, we grew. If we got 10 extra bucks, it went into the parlor or into buying a cow," she says.

Their two children were heavily involved in day-to-day operations while living at home. Now Stratton is the third member of the Quail Ridge management team and their daughter, Jordan, is director of agricultural innovation and partnerships at Colorado State University.

Growth wasn't always easy, Kraft says. "We built this new site in 2007 and the economy fell apart in 2008. Learning how to run our small dairy operation is what got us here. We knew all the parts inside and out and could see the pitfalls and opportunities. That made us good managers and business developers."

Beyond being an Agfinity owner, Kraft serves on the co-op's board of directors. The farm sells milk through the Dairy Farmers of America cooperative. "I totally believe in cooperatives. Together, we can do what we can't do individually."

Her many leadership roles include chairing the Dairy MAX board, serving on a Colorado State University sustainability advisory board, being past president of the Colorado Livestock Association and helping the Food and Agriculture Organization of the United Nations promote the importance of milk.

"I'm very community-minded. I want to put something back in the community bucket," she adds. "That's how communities thrive and not just survive."

Kraft brings that service mindset and passion for efficiency and quality to her role at Quail Ridge Dairy every day.

"About 90% of what we do here is answering key questions," she adds. "'What resources do we have? How do we deploy them? What do we want to do with the result?'

"As a manager, you're looking at all the possible combinations and deciding what makes sense for your location, the genetics you can get, the dollars available because of the milk price, etc. When you do a good job year after year, making tiny changes, it's hard to make giant leaps, but you have steady improvement." ■

LEARN MORE: Read more on Mary Kraft's approach to leadership at chsinc.com/c.

Mary Kraft, co-owner or Quail Ridge Dairy, is always looking for ways to improve efficiency while maintaining cow comfort and giving employees a rewarding work experience.

Management Finesse

Improving efficiency is a game of inches. Mary Kraft, co-owner of Quail Ridge Dairy, Fort Morgan, Colo., offers a few insights:

Optimize genetics. To reduce calving difficulty, speed genetic improvement and leverage profit opportunities, the farm uses sexed semen on first-calf heifers to produce female calves and breeds older cows to Angus bulls, selling the crossbred bull calves into a branded beef program.

"We don't keep offspring from a third- or fourth-lactation cow because, frankly, those genetics are old. I want her replacement to be better than she is."

Ensure immunity. New calves get colostrum collected from fresh cows to ensure they ingest vital maternal antibodies and to control costs. Colostrum is pasteurized in small batches, then refrigerated in bottles. About 15 minutes before feeding, the bottles are dropped into a warm water bath that gently agitates them to help the colostrum reach the perfect temperature to activate but not denature colostral antibodies.

"I'm a total believer in pasteurization." Although it takes time, "When your herd is this size, you're going to throw away a lot of milk from fresh cows, which seems really dumb. Colostrum is super high in fat and helps bulletproof calves."

Give employees the "why." "I want them to make the same decision I would make if I were there. That can only happen when they understand the concept. Since most of our employees didn't have access to that information before they got here, we create bespoke education for them, including having a veterinarian come out to talk about pneumonia, how to handle vaccines, the appropriate time to wean calves or cleanliness."

Learn from others. "We belong to a dairy tour group, so we get to see other people's facilities and ask, 'Why are you doing this?' That transparency and trading knowledge makes us all better managers."

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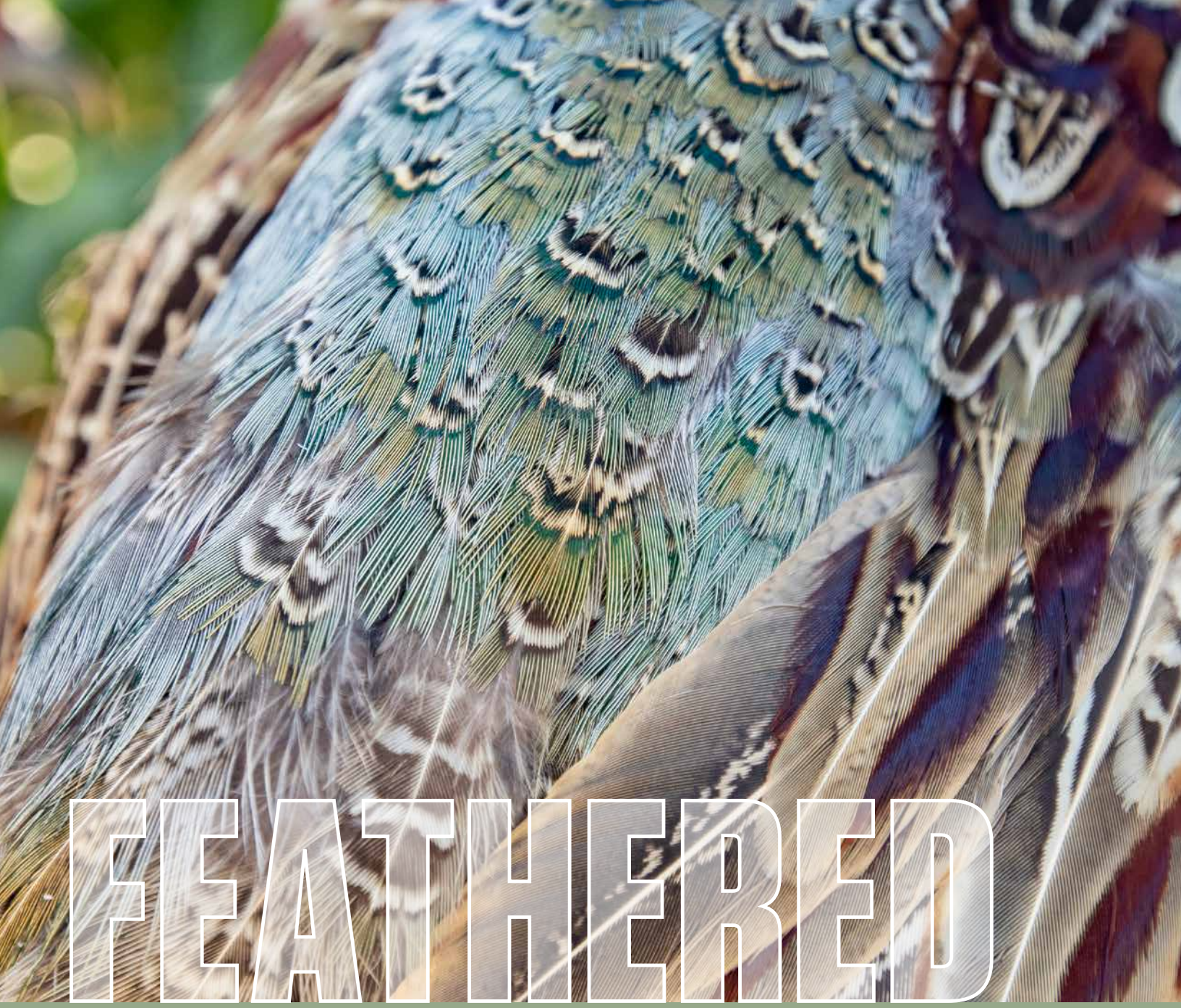

FEATHERED HARVEST

By Jennifer Chick

Fall means pheasants in South Dakota.

When leaves start changing color and the air is crisp, families and friends gather across the central United States for one of their favorite fall pastimes: pheasant hunting. Many of those birds are raised by pheasant growers like Adam and Stacey Shumaker.

The Shumakers raise pheasants in Howard, S.D. South Dakota is considered by many to be the pheasant capital of the world. Every year, more than 100,000 licenses are issued in the state, many to out-of-state visitors.

Shumaker's dad, Dale, started Top Gun Pheasant Hunting Lodge in 1991. The family raised 300 to 500 pheasants for the lodge. Adam's brother, Kevin, now runs Top Gun. After Adam and Stacey married in 2001, they decided to raise pheasants on their own. >

> "Within a couple of months of getting married, we moved to Howard to a pasture in a cornfield," Shumaker says.

They built a house and barn in that pasture and their dream quickly became reality — Shumaker Ringnecks was in business.

"We just kind of fell from the sky and raised 20,000 birds that first year," Shumaker says. "I had a lot of people tell me we wouldn't make it, but I just kept my head down and made it happen."

Adam, Stacey and their two sons, Kade, 18, and Korbin, 15, now raise 25,000 chicks each year. They receive day-old chicks from MacFarlane Pheasants in Wisconsin in monthly shipments from April through July.

"It's really fun to watch them grow, to see all our energy go into an animal and see a good final product."
— *Adam Shumaker*

When the chicks arrive at Shumaker Ringnecks, they stay indoors for six weeks.

When the birds are about 30 to 35 days old, the Shumakers, often with the help of local youth, put small devices called peepers on the pheasants. The peepers sit on the pheasants' beaks and are designed to keep them from seeing straight ahead. Shumaker says this helps prevent the birds from fighting each other.

After six weeks, they transition to outdoor pheasant pens, where they live until they are 19 to 23 weeks old, the ideal age for hunting lodges.

"It's really fun to watch them grow," Shumaker says, "to see all our energy go into an animal and see a good final product."

Nutrition for Growth

The Shumakers rely on Payback® pheasant starter and grower feed formulas from CHS. The feed is delivered directly from the CHS feed mill in Corson, S.D., often by Jay Graff, who has driven that delivery route for years. Feed arrives in 24-ton loads once or twice a month.

"There are a lot of variables when it comes to raising pheasants," Shumaker says. "Being able to depend on quality Payback feeds for over 12 years is important to our farm. Birds always stay healthy and maintain good growth. It's one of the biggest things we can count on."

Scott Connot, senior sales manager of animal nutrition at CHS, says making sure customers

Adam Shumaker and his wife, Stacey, along with their two sons, Kade and Korbin, raise 25,000 pheasants each year for hunting lodges, preserves and local customers. This bird is 14 weeks old.

At 30 to 35 days of age, pheasants are equipped with peepers, which keep them from fighting.

with specialty product needs like the Shumakers have high-quality, dependable products is important to help the brand grow.

"CHS has a wide portfolio of products that service a lot of different segments in animal nutrition," Connot says. "Historically, we've been known for our large presence in beef and dairy, but there is definitely a market to fit specialty customers as well."

Shumaker appreciates that he works with an agricultural cooperative in CHS.

"I'm just a little guy in the big scheme of things, but it's nice to know you are part of something bigger."

Pheasants Hit the Fields

When full grown, Shumaker Ringneck pheasants ship out to preserves, commercial hunting lodges and local customers within a 100-mile radius of Howard. Local customers often include friends and family who buy a few birds to release on their property a few days to a few weeks prior to when they plan to hunt.

"Pheasant hunting is a social thing," Shumaker says. "There are more people who want to come out into the outdoors. It's a vacation for them. When you come to South Dakota to hunt pheasants, it's like when other people go to Colorado to go skiing."

As requests start coming in for pheasants in late September through December, the birds are >

Korbin Shumaker pours Payback® pheasant starter into feeders for 2-week old chicks. The Shumakers have been feeding Payback pheasant feeds for more than 12 years to keep their pheasant crop healthy and growing.

Pheasants from Shumaker Ringnecks start heading to hunting lodges, preserves and private fields in late September, in time for the start of pheasant hunting season.

"When you come to South Dakota to hunt pheasants, it's like when other people go to Colorado to go skiing."
— *Adam Shumaker*

> loaded into crates and Shumaker delivers them to customers.

"I can't wait for our customers to see our birds," he says. "There is a huge demand for pheasants nationwide. I wish there were more people who could raise birds so more people could hunt."

Demand Takes Flight

The Shumakers use every square foot of their space to maximize efficiency, allotting 20 to 24 square feet per bird to minimize issues. Shumaker says he often gets more requests for birds than he can handle.

"We could sell more birds if we wanted to raise more, but you can only put so many pheasants in a pen," he says.

Bird flu has become a growing concern for pheasant growers and has contributed to pheasant shortages. The Shumakers try to empty their barns by the end of January to lessen the risk of their birds contracting bird flu. They have also put biosecurity plans in place to protect their birds.

Like traditional farming, Shumaker says there are similar seasons to raising pheasants.

"It's kind of like a crop; when farmers are planting in the spring, that's when we are getting our chicks," he says. "When they combine in the fall, that's when we are harvesting our chicks."

The first few weeks of hunting season have the Shumakers' phone ringing constantly. As the season progresses, things settle into a rhythm.

Shumaker says he likes the seasonal schedule and the process. "We work at it, and we try to put out a good product." ■

LEARN MORE: Find specialty feed information at paybacknutrition.com.

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CHS REPORTS STRONG FISCAL YEAR 2023 EARNINGS

CHS Inc. has reported net income of $1.9 billion for the fiscal year ended Aug. 31, 2023, compared to $1.7 billion for fiscal year 2022.

Key drivers for fiscal year 2023 financial results include:

- Consolidated revenues of $45.6 billion for fiscal year 2023 compared to $47.8 billion for fiscal year 2022.
- Our Energy segment delivered strong earnings, reflecting continued favorable market conditions in our refined fuels business.
- In our Ag segment, robust meal and oil demand contributed to higher earnings in our soybean and canola processing business.
- Our equity method investments performed well, particularly CF Nitrogen and Ventura Foods.

"The support of our member cooperatives and farmer-owners, dedication of our employees, exceptional operational performance and favorable market conditions enabled us to achieve the strongest earnings in our history during fiscal year 2023," says Jay Debertin, president and CEO of CHS Inc. "As a result, CHS intends to return $730 million in cash patronage and equity redemptions to our member cooperatives and farmer-owners in fiscal year 2024, demonstrating our commitment to sharing profits with the producers, local cooperatives and rural businesses that work with us to help feed people around the world.

"Our shared success showcases the unique power of the cooperative system to keep adapting and advancing through the uncertainties that can come with agriculture. We will continue to collaborate, innovate and invest to meet the growing global demand for agricultural products," Debertin adds. "A diversified portfolio, coupled with strategic investments in supply chain capabilities and emerging market opportunities, positions CHS to create a better company for the future and to maximize value for our owners and customers."

Energy: Pretax earnings of $1.1 billion represent a $458.9 million increase versus the prior year and reflect:

- A significant increase in our refined fuels income due to higher refining margins and favorable pricing of heavy Canadian crude oil — partially offset by the impact of decreased production volumes at our Montana refinery due to major planned maintenance
- Higher margins in our propane business attributed to favorable market conditions

Ag: Pretax earnings of $411.8 million represent a $245.8 million decrease versus the prior year and reflect:

- Decreased margins for wholesale and retail agronomy products, which experienced market-driven price declines compared to historically high prices in the previous year
- Lower margins for ethanol as market prices declined
- Negative impact of mark-to-market adjustments on grain and oilseeds
- Margin increases in our oilseed processing business, bolstered by strong meal and oil demand

Nitrogen Production: Pretax earnings of $260.8 million represent a $217.2 million decrease versus the prior year due to lower equity income from our CF Nitrogen investment attributed to decreased market prices of urea and UAN.

Corporate and Other: Pretax earnings of $259.8 million represent a $201.9 million increase versus the prior year and reflect, among other factors, increased equity income from our Ventura Foods joint venture, which experienced more favorable market conditions for edible oils, and increased interest income.

CHS INC. EARNINGS* BY SEGMENT (in thousands $)

	Years Ended August 31	
	2023	2022
Energy	$1,075,443	$616,551
Ag	411,808	657,586
Nitrogen Production	260,760	477,985
Corporate and Other	259,768	57,895
Income before income taxes	2,007,779	1,810,017
Income tax expense	107,655	132,116
Net income	1,900,124	1,677,901
Net (loss) attributable to noncontrolling interests	(314)	(861)
Net income attributable to CHS Inc.	**$1,900,438**	**$1,678,762**

Earnings is defined as income (loss) before income taxes.

GET MORE: Sign up to receive CHS press releases by email or RSS feed at chsinc.com/news.

CHS INTENDS TO RETURN $730 MILLION TO OWNERS

CHS has announced it intends to return $730 million in cash patronage and equity redemptions to its owners in calendar year 2024. The decision demonstrates the cooperative's ongoing commitment to sharing profits with its owners and strengthening rural communities.

The CHS Board of Directors determines the total amount of cash to be returned to CHS owners at the close of each fiscal year. Based on business done with CHS in fiscal year 2023, which ended Aug. 31, 2023, the CHS Board has elected to return $365 million in cash patronage and $365 million through equity redemptions to CHS owners.

The cash returns earmarked for distribution in 2024 will combine with the previous year's cash returns for more than $1.7 billion shared with owners over two years and more than $3.2 billion returned to owners over the past 10 years.

"As a cooperative, CHS was founded in the commitment to share financial strength with its owners while growing capabilities and efficiency to help our owners, customers and business partners succeed," says Dan Schurr, chair of the CHS Board of Directors. "No other business model has this deep connection with its owners and unrelenting focus on empowering our stakeholders and building communities."

CHS FOUNDATION COMMITS $4.3 MILLION TO FFA

The CHS Foundation Board of Trustees has approved a nearly $4.3 million gift to National FFA over the next three years to help develop the next generation of leaders and build a future talent pipeline for agriculture and the cooperative system.

The gift — the largest in the foundation's 75-year history — will help fund FFA programs in 17 states, provide FFA scholarships, support workforce development program efforts to introduce students from all backgrounds to ag careers and strengthen National Association of Ag Educators programs.

"The CHS Foundation is thrilled to make this strong commitment to FFA to help support excellent ag educators and hands-on learning experiences," says David Kayser, CHS Foundation Board of Trustees chair. "I've seen firsthand how ag teachers and involvement with FFA inspires students from all backgrounds to pursue careers in agriculture."

Rachel Sauvola, center, an agriscience educator at New Richmond, Wisc., and other ag teachers will benefit from a three-year gift of nearly $4.3 million by the CHS Foundation to National FFA.

PLENISH® SOYBEAN PRODUCTION CONTRACTS AVAILABLE FOR 2024

Production contracts for 2024 are now available for Pioneer® brand Plenish® high-oleic soybeans. Developed for southern Minnesota and northern Iowa growing conditions, Plenish high-oleic soybeans help enhance soybean market opportunities and provide direct benefits to the food industry, consumers and growers.

Contact Joe Zingrone or Luke Johnston at 800-642-0046 or visit **CHSag.com** for additional information.

Pioneer® brand products are provided subject to the terms and conditions of purchase, which are part of the labeling and purchase documents. Pioneer and Plenish are trademarks of Corteva Agriscience and its affiliated companies.

It's time to secure 2024 contracts for high-oleic soybean acres.

HOMETOWN THROWDOWN

Cenex® has launched Hometown Throwdown, a contest encouraging local pride by asking people and organizations to share what makes their hometown festivals unique. Qualifying festivals have a chance to win up to $100,000 to bring the celebration to the next level.

Hometown Throwdown highlights unique celebrations that bring communities together and foster community pride. People and organizations can nominate festivals by posting a photo to Facebook, Instagram (tagging @CenexStores) or TikToK (tagging @CenexStores_) and using the #PoweredLocally and #Contest hashtags. Entries must be posted by Dec. 15, 2023.

Learn more about the contest and find an online entry form at **cenexhometownthrowdown.com**.

Grizzly Guard

"Landowner-led and community-driven" is how Wildlife Program Coordinator Eric Graham describes his organization, Blackfoot Challenge, and the complex situation that faces residents in beautiful northwest Montana.

Area ranching families produce essential livestock with their growing cow-calf operations. Their impressive homesteads are part of the diverse landscape, which includes clear blue rivers and dense green and gold forests.

The grizzly bear population has also grown here over the last 20 years and grizzlies are often seen on private lands across Montana. Potentially a thrilling sight from afar, these creatures threaten vulnerable calves and even humans. "My job is to get all the parties involved and help everyone communicate their needs so we can all live and work together," says Graham.

Solutions he and the Blackfoot Challenge provide to maintain harmony include permanent and temporary fencing, bear-proof waste receptacles and carcass collection.

"We have the best customers in the world," says Dusty Smith, operations manager for the CHS ag retail location at Missoula, Mont. "This is another way we can support them." Smith nominated the Blackfoot Challenge for a CHS Seeds for Stewardship matching grant to help fund the program.

In this region where community means fish, livestock, wildlife and people, Graham and the Blackfoot Challenge are building connections and strengthening communities by making the landscape safe for people and wildlife.

— Adam Hester

Eric Graham and Blackfoot Challenge are using a CHS Seeds for Stewardship matching grant to help protect livestock and people from Montana's growing grizzly bear population.

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C TOMORROW

Working Harder and Smarter

CHS agronomy custom application equipment and tender trucks are getting smarter.

The cooperative is investing in new software and hardware for nearly 600 sprayers, floaters and tender trucks to optimize its agronomy fleet. The technology allows application prescriptions and field maps with GPS coordinates to be uploaded to applicators from dispatch centers. Dispatchers can remotely monitor job progress and when machines need to be refilled, electronically assign jobs based on geographic location and check equipment status.

"By moving away from mostly paper and phone calls to a digital system, we're optimizing logistics to apply products more efficiently," says Keith Schumacher, vice president of operations and project lead. "These insights for our custom application fleet and delivery trucks will allow our operations teams to cover more acres in the same time window. Utilizing these technologies improves service and customer experiences.

"It will also help us meet owner needs while growing our custom application business and rightsizing our fleet."

Initial analyses showed application equipment was working in the field only about a third of the time, with the rest of the time divided between traveling and sitting idle. The goal is to increase the time the application fleet is applying product to fields for optimal fleet management and asset utilization, Schumacher says.

"You're not servicing customers if the machine isn't applying product," he adds.

— Matthew Wilde