

A combine harvester is shown from a low angle, moving through a field of golden-brown grain. The sun is low on the horizon, creating a warm, golden glow and long shadows. The harvester's header and auger are visible, cutting through the stalks. The sky is a pale blue with a soft orange glow near the horizon.

Heartland HARVEST

Wednesday, September 20, 2023

The
Brookings
Register

SDSU encourages South Dakotans to join Crunch Off

BROOKINGS — SDSU Extension is encouraging South Dakotans to join a statewide event promoting locally grown fresh fruits and vegetables.

The South Dakota Crunch off celebrates local produce and SDSU Extension's Farm to School programs with a friendly interstate competition to see which state's residents can encourage the most residents to eat local fruits and vegetables from Sept. 18 to Oct. 13.

In celebration of Farm to School Month in October, states around the region – Colorado, Missouri, Kansas, Nebraska, North Dakota, Montana, South Dakota and Wyoming – are competing to get the most crunches per capita.

Anyone can participate, including schools, clubs, families and businesses. To join the Crunch Off, register a team, crunch into any South Dakota-grown fruit or vegetable as a team, and post a photo or video to social media with #SoDakCrunch to help South Dakota win the Crunch Crown. Take it one step further by pairing the crunch with educational activities. SDSU Extension



is providing downloadable worksheets, crafts and lessons for all ages on extension.sdstate.edu.

Farm to school is a program model

used across the nation, including South Dakota, to assist schools with local food sourcing, school or youth gardens, and local foods education. Crunch Off is one

activity to encourage youth to develop healthy eating habits.

"Serving local foods to youth has been shown to increase acceptance of fruits and vegetables," said Anna Tvedt, SDSU Extension nutrition field specialist and registered dietitian. "Getting youth excited about fruits and vegetables sets them up for a healthy future."

Tvedt said purchasing local foods also stimulates the local economy and supports area growers.

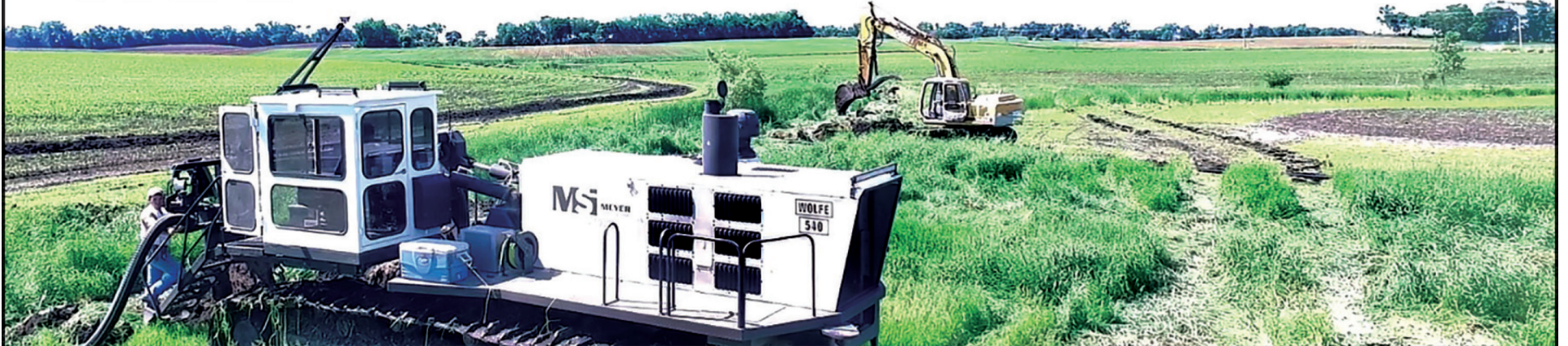
"It's health-promoting for all ages to pause and enjoy local produce," she said. "All ages, not only youth, are encouraged to participate."

To register, visit the SDSU Extension Events page and search "Crunch".

For more information on Farm to School, visit the Farm to School page. For more information on South Dakota Crunch Off, contact Anna Tvedt, SDSU Extension nutrition field specialist; or Claudia Botzet, SDSU Extension nutrition field specialist.

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Bart Pfankuch/South Dakota News Watch

South Dakota farmers, such as this one south of Madison, are keeping a close eye on the state's trade relationship with China, which is a major importer of products from the Rushmore State.

On China trade, SD farmers face 'uneasy balance'

BART PFANKUCH
South Dakota News Watch

As political apprehension over the U.S.-China relationship rises, South Dakota farmers find themselves forced to think more globally and find a way to support American national security interests while protecting their own need to make a living.

On the one hand, South Dakota farmers want to maintain their industry's existing relationship with China, which represents the state's largest international importer of South Dakota agricultural products.

In 2022, China spent roughly \$1.4 billion a year to purchase soybeans, dairy products and meat raised in the Rushmore State.

"Pork is their main protein source, and they're very large consumers of pork, so we're very concerned about

the trade relationship we have with them," said Glenn Muller, director of the South Dakota Pork Producers Council. "China is one of our major markets we look to, along with Japan and Mexico, so we're very concerned about maintaining those markets."

At the same time, farmers are aware of the increasingly strong rhetoric among U.S. government officials to keep America safe from Chinese interventions, be it from spy balloons floating across the skies, by social media platforms like TikTok, through threat of cyber attacks and even potential military aggression.

Farmers who want to keep a strong trade relationship with China also support efforts by national and state politicians to talk tough and increase restrictions on the ability of the communist country to buy land, run businesses or make other inroads into American life, commerce and

security.

"We realize our governments are having issues, real national security issues, and we totally understand that those need to be addressed," said Jerry Schmitz, director of the South Dakota Soybean Association.

Soybean growers, whose product is the top commodity shipped from South Dakota to China each year with a value of \$1.2 billion, are trying to toe a fine line in supporting their government while also feeding the world – and their own families at home, he said.

"We certainly need to protect our country first. However, we're also selling a product to feed China's people, and we see that people are different from their government," Schmitz said.

CHINA: Purchases almost 30 percent of South Dakota goods

Continued from page 3

Billions of dollars in play

Overall, South Dakota exports about \$6.7 billion worth of goods and services to foreign countries each year, about \$5 billion of which is from agricultural products.

China remains a critical market for numerous South Dakota goods and services, serving as the top export destination for goods produced in the state and as the third-largest importer of services originating in the state, according to the U.S.-China Business Council.

In 2022, about 28% of goods produced in South Dakota were sold to China, and 5% of global services exports headed there that year, the council reported. South Dakota saw a 14% increase in goods sold to China from 2020 to 2022, the council said.

The top exported goods to China that year were soybean oils, seeds and grains, with \$1.2 billion in sales, followed by dairy products (\$30 million), medical equipment (\$24 million), paper products (\$16 million) and meats (\$13 million.) The top services provided by South Dakota to China were credit-related services with \$28 million in annual sales, followed by other financial services (\$25 million.)

Volatility evident in pork market

South Dakota pork producers were provided an example in the volatility of international markets over the past few years.

Hog farmers in South Dakota and across the U.S. saw a boost in export levels to China over the past three years or so as the Asian country battled a devastating outbreak of African swine fever in its own hog farms, Muller said.

But of late, China has rebuilt its internal pork production, which has reduced the need for foreign imports, including pork from South Dakota, he said.

"They had to import more products to supply the protein needs for their consumers because they lost most of their herd," Muller said. "But since they've rebuilt their herd, there's less reliance on imports."

The U.S. pork industry exports about 27% of its total production of pork, with top markets in China, Japan and Mexico



among others, Muller said. South Dakota is home to about 800 pork farms that produce about 3.1 million hogs a year, he said.

The South Dakota agriculture industry is aware of and concerned about the growing anti-China political rhetoric that has arisen in the U.S. in recent years, including by Gov. Kristi Noem, he said.

The governor included China on her list of "evil foreign governments" that the state should not contract with and also banned state use of Chinese-owned Tiktok. Noem and U.S. Sen. Mike Rounds have also sought to limit Chinese ownership of land in the U.S.

"The largest risk to America's security is posed by the Chinese Communist Party – including to our financial security," Noem wrote in August to the investment firm Vanguard, urging the company to divest from China in one of its largest international funds.

One example of the complicated relationship with China is that while Noem and others are working to limit Chinese influence, the country is home to the meat producing conglomerate that owns Smithfield Foods. It operates a large pork processing plant in Sioux Falls that serves producers across the region and employs about 3,700 people.

ing options.

The continued concerns make it likely that some type of shift in America's trade relationship is imminent, he said.

"The U.S.-China relationship is undoubtedly the most frequently talked about or discussed trade matter at this time," Lindberg said. "There's a largely bipartisan consensus in Washington that the existing U.S.-China relationship over the past several decades hasn't yielded the results that the U.S. would consider to be positive, so there needs to be a change in that relationship to level things out or a full reset."

South Dakota Trade hosted an event in Sioux Falls on Aug. 23 called the Midwest Agricultural Export Summit, which included a session on U.S.-China trade relations.

The world beyond China

Lindberg said volatility in the ongoing trade relationship with China was shown in a 25% decrease in U.S. imports from China in the first half of 2023, which could also result in a decrease in U.S. exports to China.

"China is looking elsewhere to procure their commodities," he said. "They're actively looking for alternative suppliers, and we at the same time need to be looking at alternative buyers."

Those target markets for expanding South Dakota trade goods are likely to include Mexico, already a strong trade partner, as well as newer markets in Africa and East Asia, Lindberg said.

"As our relationship (with China) frays, there is a need for us to have other market opportunities to sell our goods around the world," he said. "We need to be able to help build and foster new relationships around the world that build resilience in our export markets."

South Dakota Trade has planned its first international visit with a planned trip to Mexico by Lt. Gov. Larry Rhoden, state Agriculture and Natural Resources secretary Hunter Roberts and representatives of the soybean industry, Lindberg said.

Trade wars painful for producers

Previous attempts to gain political advantage over a country by restricting trade with that nation have historical-

Chinese investors seek stability

The challenge of balancing those competing concerns with China is readily apparent when Chinese buyers visit and speak with South Dakota producers, Schmitz said. Those buyers want to know that if they begin trade with South Dakota that they can rely on the relationship to remain stable and provide a consistent flow of food products.

"This is a way to have a toe in the door, and while we do get questions from Chinese folks about why the rhetoric is so harsh, we feel it's against their government and not their common people," he said. "So, in terms of our relationships with customers, it is a concern, but also, we want to make sure we maintain the communication back and forth so we can curry favor with that nation."

China concerns may prompt trade changes

The national security concerns over the U.S.-China relationship are bipartisan in nature and partly originate within concerns that the trade relationship between the two nations has not been as positive for the U.S. as it has for China, said Luke Lindberg, CEO of South Dakota Trade, an organization formed this year to bolster state trad-

Continued from page 4

ly been bad news for American farmers, agricultural group leaders said.

The grain embargo with the former Soviet Union in 1980 was damaging to the U.S. agricultural industry as was former President Donald Trump's trade war with China, which in 2018 cut South Dakota imports to China by more than half, they said. Schmitz noted that the Trump administration enacted a program to provide financial help to farmers with losses.

China is a bonafide concern for the U.S., as the communist country remains the holder of huge levels of American debt and has a terrible record on human rights, said Michelle Bekkering, a director with the U.S. Global Leadership Coalition who spoke at the recent export summit in Sioux Falls.

Midwest farmers should not expect an easing of tensions with

China anytime soon and must be prepared for any change and further tensions that may come, said Bekkering, an Iowa native who grew up on a soybean farm..

"There's always going to be this friction between what we see going on in China and how we get ahead of it and be wary," Bekkering said. "But how do you rectify that with your soy producers who say, 'Don't cut off our markets.' I would call that an uneasy balance."

China concerns valid

Bekkering said U.S. leaders should be "wary" of China because in her 25 years of experience in international development, she has seen that China may be a financially valuable partner but requires caution.

"This is not a country with our same values," she said. "Chinese investments and relationships are never symbiotic or a two-way street. China is

always looking out for No. 1."

And yet, Bekkering also does not believe that the U.S. trade relationship will be cut off in dramatic fashion anytime soon.

"Back in the heartland, you have to have these frank and honest discussions, but our economy here is really dependent on them," she said. "We need to work for balance and fair trade. But at the same time, we can't pretend that we're going to just decouple from China because it's just not practical at the end of the day."

American farmers, meanwhile, should continue to protect their Chinese interests and also begin to look elsewhere to diversify their trading options, Bekkering said. She was pleased to see groups like South Dakota Trade taking a lead role in expanding market opportunities.

"You will not see a cessation in trade with China, and we

need to continue to work diplomatic angles to make sure our producers and our manufacturers are getting their fair share," she said. "But meanwhile, let's make sure we are on the ball and really investing and building up those new markets."

New markets, new products Enhancing trade opportunities for South Dakota farmers is likely to not only include new trade markets but also new ways to sell goods produced in the state, Schmitz said. Soybeans and byproducts long used as human food and animal feed can also be used to replace rubber in tires or be part of a move to alternative fuels, he said.

Building new trade relationships must be an ongoing process, and it takes patience and diligence to establish a stable partnership, Schmitz said.

"The U.S. soybean organizations were in China 20 years before we sold our first soybean,"

he said. "To diversify in other countries, it takes time, building trust, relationships and facilities. It's not an overnight thing. It's a slow build upwards."

And when it comes to China specifically, Schmitz said soybean producers in South Dakota hope that commerce centered around food can overcome any political battles and be seen instead as a way to build bridges through shared humanity.

"We know buyers are asking the question, 'Are you a reliable supplier because we see people in your country saying you shouldn't be trading with China, so are we next?'" Schmitz said. "But we have our own lives to live and they do as well in China, and we actually believe that these goods can be used as a tool of peace."

— This article was produced by South Dakota News Watch, a non-profit journalism organization.

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Biden spending \$150M to help small forest owners

BRUNSWICK, Ga. (AP) — The Biden administration said recently it will spend \$150 million to help owners of small parcels of forestland partner with companies willing to pay them for carbon offsets and other environmental credits.

Agriculture Secretary Tom Vilsack announced the grant program at a conference of Black landowners in coastal Georgia, saying programs that allow private companies to offset their own emissions by paying to protect trees have disproportionately benefited owners of large acreage.

“In order for those small, privately held forest owners to be able to do what they need and want to do requires a bit of technical help,” Vilsack told about 150 conference attendees in a church ballroom in Brunswick. “And sometimes that technical help is not easy to find. And it’s certainly not easy to afford.”

The grant money comes from the sweeping climate law passed by Congress just over a year ago and targets underserved landowners, including military

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FOREST: Goal is to help protect smaller tracts

Continued from page 6

veterans and new farmers, as well as families owning 2,500 acres or less.

The goal is to protect more tracts of U.S. forest to help fight climate change. The past decade has seen a rapidly expanding market in which companies pay landowners to grow or conserve trees, which absorb carbon from the atmosphere, to counterbalance their own carbon emissions.

For owners of smaller family tracts, selling carbon offsets or other credits would give them an alternative income to harvesting their timber or selling their property to a developer.

Companies are pouring billions of dollars into environmental credits, but small landowners face daunting barriers to eligibility, said Rita Hite, president and CEO of the American Forest Foundation.

To participate, owners need to take an inventory of their forested property, have a land management plan and run models to calculate the land's carbon value.

"Previously, if you didn't have 5,000 acres or more, you weren't participating in these markets," Hite said. "Not only are there technical hurdles, but also financing hurdles."

The American Forest Foundation and the Nature Conservancy launched a joint program four years ago that covers many of the costs for family land owners to sell carbon offsets for their land.

Those groups and other nonprofits will be eligible to apply for grants of up to \$25 million to provide direct help to landowners under the Biden administration's program.

So will state forestry agencies, university agricultural extension services and

others. The money could pay professionals to help owners develop land management plans or to connect them with project managers who serve as middlemen between owners and companies seeking environmental credits.

The grants were welcomed by John Littles, a leader of the Sustainable Forestry and African American Land Retention Network hosting the Georgia conference. The group represents 1,600 Black landowners across eight Southern states — Alabama, Arkansas, Georgia, Mississippi, North Carolina, South Carolina, Texas and Virginia.

"Most of the time, we're left out — more specifically people of color," Littles said. "We're not afforded the opportunity to help design the programs, so the programs are mainly now designed for large landholdings and large acreage."

Littles said his network plans to apply for a grant under the new program. But he's not sure how much demand there will be from landowners. He said that will largely depend on whether owners of smaller acreages can get enough money from conservation credits.

"I think it's still early to tell," Littles said. "But it has to be a benefit for the landowners."

Hite of the American Forest Foundation said landowners with small acreage shouldn't expect big profits from selling environmental credits. She said owners enrolled in the group's Family Forest Carbon Program earn on average about \$10 per acre in a year.

"Is this going to matter for a 30-acre landowner? It's not going to make them rich," Hite said. "But it will probably pay the taxes."

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SDSU researcher seeks to improve organic yields

BROOKINGS — Organic farming — in the United States and South Dakota — is on the rise.

According to the Pew Research Center, the number of organic farms in the U.S. was estimated around 14,000 in 2016 — a 56% increase from just five years earlier. In 2021, despite economic and production challenges, total sales of organics reached an all-time high at \$11.2 billion.

Researchers from South Dakota State University have taken notice of this growing industry and are looking for ways to address the major challenges organic producers face.

Through a four-year, \$749,998 grant from the USDA National Institute of Food and Agriculture, SDSU assistant professor Sutie Xu is looking to demonstrate if “living mulch” can improve soil health, agronomic performance and the profitability of organic vegetable systems.

A changing industry

“Organic farming is developing very quickly in the U.S.,” said Xu, a researcher in SDSU’s Department of Agronomy, Horticulture and Plant Science. “Based on data from 2022, in South Dakota, there were only 138 organic farms, which was lowest number among the states in Midwest, and less than 15 of them were used for vegetable production. South Dakota stakeholders have expressed great interest in information on organic vegetable management strategies to improve profitability and sustainability.”

The roots of organic farming can be traced back to the widespread use of herbicides, pesticides and fertilizers in conventional food production systems in the early 1900s. As a natural alter-



Courtesy photo

A study from Sutie Xu, a researcher in South Dakota State University’s Department of Agronomy, Horticulture and Plant Science, is looking to demonstrate if “living mulch” can help improve organic vegetable yields.

native, some producers began growing crops without any additives. Organic produce quickly grew in popularity as people began looking for different food options at grocery stores.

Today, U.S. Department of Agriculture regulations prohibit organic

producers from using pesticides and/or synthetic fertilizers and outline requirements on crop and soil management.

Fertilizers, despite their negative human and environmental impacts, have proven benefits for crop production systems, particularly in terms of

the yield that can be produced. Yield size is one of the primary struggles for organic producers. Smaller yield sizes require more land to be farmed (in comparison to conventional farming). More land means a greater environmental

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Some of the most widely used PA tools include: global positioning system receivers, yield monitoring and mapping, remote sensing via drones and geographic information systems.

Barriers to adopting precision ag practices

BROOKINGS — Precision agriculture technologies help optimize returns on crops and livestock while using resources as efficiently as possible. However, many farmers—specifically those in the Upper Midwest—still see many barriers to adopting PA practices, according to a new study from Tong Wang and Hailong Jin, associate professors in South Dakota State University's Ness School of Management and Economics.

"PA improves farming efficiency and management, but challenges prior to and following PA adoption can prevent farmers from widely using it," Wang said. "This research aims to understand the barriers perceived by farmers at different usage stages."

Precision agriculture is an overarching term for a wide array of farming technologies that aim to address the spatial and temporal variability of the field and promote farming efficiency. Some of the most widely used PA tools include: global positioning system receivers, yield monitoring and mapping, remote sensing via drones, and geographic information systems, among many other technologies.

Barriers to PA adoption and more

In the summer of 2021, Wang sent out a survey to farmers in South Dakota, North Dakota, Minnesota and Nebraska. More than 1,100 corn producers responded

to questions regarding their views towards potential challenges posed by PA technologies. Of all respondents, 59% have adopted at least one PA technology from all three categories (georeferencing, diagnostic and application technologies), compared to 14% who have not adopted any PA technologies. Their concerns were organized into four categories: cost concerns, technology concerns, complexity concerns, and infrastructure and support concerns.

"If challenges faced by producers are not addressed, it could constrain the widespread adoption of PA technologies," Wang said.

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ORGANIC: Would improve profitability

Continued from page 11

impact—a concern to researchers and organic producers.

“Without the chemical inputs, it can be difficult to get sufficient nutrients to the organic vegetables,” Xu said. “Producers have to instead rely on organic nutrients, like livestock or chicken manure. However, not all farms have access to manure. Alternative options are needed.”

Finding a natural alternative to synthetic fertilizer would greatly help the viability, sustainability and profitability of organic farms. Xu is investigating ways to improve vegetable yields on organic farms in South Dakota with living mulch.

Cover crops as living mulch

Cover crops are a proven sustainable agriculture practice that is becoming widely adopted. Following a cash crop harvest, cover crops — like rye or buckwheat — are planted. After a few weeks

of growth, the crop will cover the soil, thus slowing erosion and improving soil health. Research conducted by faculty members at SDSU show that cover crops improve cash crop yields.

For this project, Xu and her collaborators Kristine Lang, assistant professor in the Department of Agronomy, Horticulture and Plant Science; Peter Sexton, associate professor and SDSU Extension Sustainable Cropping Systems Specialist; Thandiwe Nleya, professor in the Department of Agronomy, Horticulture and Plant Science; Rhoda Burrows, professor in the Department of Agronomy, Horticulture and Plant Science; Tong Wang, associate professor in the Ness School of Management and Economics; and Navreet Mahal have proposed using perennial clovers in a similar way to cover crops. Instead of planting these crops following a harvest, the clovers will be planted before the three vegetables being utilized in this study: squash, cabbage and sweet

corn. The clovers will function as a “living mulch” as they grow alongside the cash crops.

Clovers as living mulch have been previously shown to suppress weeds, retain water and improve soil health. Clovers are also a “nitrogen fixer” and can provide nitrogen to crops in a similar fashion to synthetic fertilizers.

“Legumes can sequester nitrogen from the atmosphere, and clovers are a type of legume,” Xu said.

During growing seasons, the research team will take soil and plant samples to determine what benefits the living mulch is providing to the soil and the crops. Following the trial phase, the research team will conduct an economic analysis.

“The data generated from this project will fill an important research gap in organic vegetable production and provide valuable information on sustainable vegetable production,” Xu said.

Research field days and webinars

are also planned during the latter years of the project to share the newfound knowledge on organic vegetable production systems.

“This project will provide information and knowledge to producers and other stakeholders on sustainable organic vegetable management with lower reliance on manure and tillage,” Xu said.

While the U.S. has seen an exponential rise in the number of organic farms, South Dakota’s growth has been considerably slower, primarily due to challenging climatic conditions. Xu is hopeful this research will provide valuable information to benefit, and ultimately grow, organic farming in South Dakota.

“We hope to promote organic vegetable production in South Dakota and other areas with similar climatic conditions and therefore contribute to growth of overall organic farming in the U.S.,” Xu added.

— From SDSU Extension



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Climate change will force more irrigation

Associated Press

The Texas ranch where Gilda Jackson trains and sells horses has been plagued by grasshoppers this year, a problem that only gets worse when the hatch quickens in times of heat and drought. Jackson watched this summer as the insects chewed through a 35-acre pasture she badly needs for hay; what they didn't destroy, the sun burned up.

Irrigation might have saved Jackson's hay, but she and her husband rejected the idea about 10 years ago over the cost: as much as \$75,000 for a new well and all the equipment. But now — with an extended drought and another U.S. heat wave this week that will broil her land about an hour northwest of Dallas for days in 100-degree-plus temperatures — Jackson said she is "kind of rethinking."

Many other farmers and ranchers in the U.S. might be forced to do the same in coming decades, according to recent research into the expected effects of the rising heat and more frequent weather extremes associated with climate change.

That's if they even can. Some places in the U.S. are already struggling with groundwater depletion, such as California, Arizona, Nebraska and other parts of the central Plains.

"There's no surprise that in the future when it gets hotter and there's more demand for water, people are going to be using more water," said Jonathan Winter,

an associate professor of geography at Dartmouth College and an author on a new study on future U.S. irrigation costs and benefits in *Communications Earth & Environment*.

Winter and his team used a computer model to look at how heat and drought might affect crop production by the middle and end of this century, given multiple scenarios for the emissions of warming greenhouse gases. In places like California and Texas where "everyone is dropping their straw into the glass" of groundwater, as Winter put it, current levels of irrigation won't be viable in the long term because there isn't enough water.

But use of irrigation may grow where groundwater supply isn't presently an issue.

In much of the Midwest, including the corn- and soybean-rich states of Iowa, Illinois, Indiana and the Dakotas, farmers might see a benefit in the next 50 years from installing irrigation infrastructure. That's an expensive investment, and whether it will pay off may depend on humans' ability to stem the worst effects of climate change. A worst-case scenario would involve one generation investing in costly irrigation equipment, only for the next to see them fail to keep crops alive through extreme heat and weather.

There are many irrigation methods for row crops, but the most common is pivot irrigation — the long strands of pipes

mounted on wheels that are pulled in a circle around a water source to sprinkle water onto a field. The equipment can easily cost hundreds of thousands of dollars, plus the cost of drilling a new well if needed, along with the electricity to pull up the water.

But if the system boosts yields and provides a return of \$50 an acre or more, it can pay off well for a farmer, said Brady Brewer, an associate professor of agricultural economics at Purdue University.

While scientists are confident in the warming effects of greenhouse gas emissions, precipitation is harder to nail down, especially in the Midwest, said Dave Gochis, a senior scientist with the National Center for Atmospheric Research who was not involved with Winter's study.

Climate change produces more weather extremes, meaning both an increased risk of flash droughts — quick, intense periods of short-term heat and dry weather — and more heavy rain and flooding events as precipitation increases with more water in the atmosphere.

"That means we need to be more nimble and agile in how we manage water resources," Gochis said.

Brewer hasn't seen much increased interest in irrigation from Midwest farmers yet. So far, a surplus of water has been the bigger issue in many places, but if yields start showing losses in the coming years due to worsening heat and

flash droughts, "that's when farmers will invest," he said.

Farmers who don't choose irrigation, for now, might cope by planning ahead.

They could choose different crops with different water needs from season to season or be compensated for fallowing fields in times of water stress. Or they might use tools like the one developed by North Carolina State researchers Sankar Arumugam, a professor, and Hemant Kumar, a Ph.D. candidate.

They recently helped create a computer modeling tool, outlined in the journal *Water Resources Research*, which they hope will help farmers and water managers use a combination of seasonal forecasts and other data to find a sweet spot for balancing crop revenue and water use.

In the Southeast, where they focused their work and where water resources are plentiful, "it's more of a proactive strategy" for people who already have irrigation equipment, Arumugam said, "so that we don't overexploit the resources that are in place."

Irrigation, used responsibly, can be part of adapting to climate change, but "it's a moving target," Winter said.

He called for supporting farmers who have to make hard decisions as they adapt to climate change — for instance, training them to grow less water-intensive crops or giving them low-cost loans to improve irrigation efficiency.

PRECISION: Startup costs present hurdle

Continued from page 12

Producers agreed that cost concerns, including initial investment costs, annual subscription costs for software, maintenance and operating costs, were the top issue in regard to PA technology adoption. Of all producers, 60% felt that PA equipment and services were too high. Producers who had not adopted any forms of

PA were more likely to say costs were the highest barrier to entry. Costs became less of an issue for producers who were more experienced with PA tools.

To overcome this barrier, the researchers theorized that monetary support, in the form of farm loans and subsidies, for new adopters of PA technology as a possible solution.

For farmers experienced with PA technologies, one of

the biggest concerns was brand compatibility. Data privacy is also one of the major concerns regardless of the adoption status.

Data shows that age, farm size and education all play a role in the perceived barriers to adoption.

"The results from this study convey that producers with varying experience in PA technologies have different views

regarding the main challenges towards PA usage and adoption," Wang said.

Previous research has shown the adoption of PA technologies also has public benefits. These include decreased fuel consumption, reduced greenhouse gas emissions and improved water quality in surrounding waterways due the efficient usage of fertilizers and pesticides.

"Findings from this study

can aid PA stakeholders in identifying target groups, tailoring future development, research and outright efforts, and ultimately promoting efficient PA usage on a broader scale," Wang said.

The full study can be found here: doi.org/10.1007/s11119-023-10048-2

— From *SDSU Extension*



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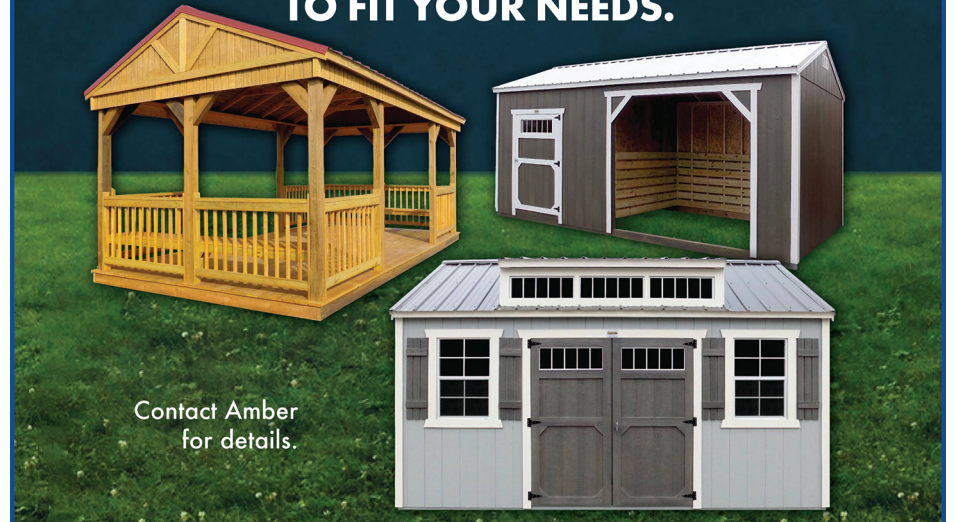
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