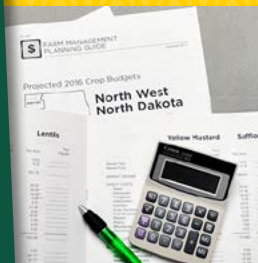
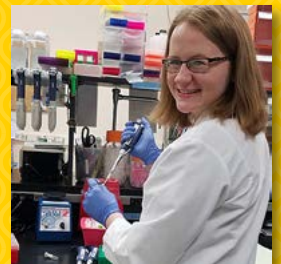


North Dakota Agricultural Experiment Station
NDSU Extension Service

2016 Annual Highlights



An Investment in North Dakota's Agricultural Economy and People



Ken Grafton



Chris Boerboom

.....

North Dakota Agricultural Experiment Station mission:

Develop and disseminate technology important to the production and utilization of food, feed, fiber and fuel from crop and livestock enterprises. The research must provide for an enhancement of the quality of life, sustainability of production and protection of the environment.

.....

NDSU Extension Service mission:

Create learning partnerships that help youth and adults enhance their lives and communities. This purpose is accomplished through the dissemination of research-based information and the implementation of educational programs geared to the changing needs of North Dakotans.

.....

We are pleased to share the valuable accomplishments of the North Dakota Agricultural Experiment Station (NDAES) and NDSU Extension Service in our 2016 Annual Highlights. Our missions contribute directly to the economic success of North Dakota's agriculture and meeting the needs of our residents.

In this report, you will read about important research that advances and sustains agriculture as the leading economic sector in North Dakota. The agricultural economy is facing challenging times, and NDAES scientists are applying innovative technologies to improve cultivars, increase production levels and gain efficiency with the goal of improving farm profitability.

This report provides a snapshot in time of these accomplishments and some of the driving forces behind a vibrant and ever-changing agricultural system. Research invested through time on plant genetics and quality, product uses, nutritional value, pest management, soil health, and marketing and risk management tools contributed to this success of North Dakota agriculture. Similarly, research in nutrition, handling, meat quality and management of livestock for this region of the country has improved this very important sector of agriculture.

The use of unmanned aerial systems (UAS) of various sizes will become more commonplace as sensor technology, data management and data analyses improve and become more user-friendly. However, the rapid increase in interest in UAS often overshadows the other accomplishments in the precision ag sector that have increased profitability and reduced risk. Other examples of our varied research programs are provided throughout this report.

The NDAES secures partnerships with industry, other universities and federal scientists to ensure that we have access to innovative technology to solve the range of issues facing our crop and livestock producers in the state. Continued investment in NDAES research will continue to generate positive outcomes for North Dakota farmers, ranchers and industry.

To best serve the needs of North Dakotans, the NDSU Extension Service held community forums in the fall of 2015 to update our understanding of concerns and challenges. Within the areas of agriculture, the economy, energy, natural resources, children, family and communities, we heard a call for assistance. The needs centered on building agricultural and economic prosperity, driving community engagement and producing healthy citizens.

The input from the forums will guide our future efforts, but Extension is pleased to know that many of our current programs target today's high-priority challenges. To achieve the positive outcomes of these educational programs, Extension relies on exceptional specialists who develop research-based management recommendations. Extension specialists optimize their efficiency by working in close partnership with the NDAES, industry and agencies. Extension education is delivered locally, where talented agents and educators, through the support of their counties, are able to refine Extension information based on local conditions. The state, county and federal investment in the NDSU Extension Service provides locally relevant programs that truly change lives.

We sincerely hope you enjoy reading the 2016 Annual Highlights!

North Dakota is ranked

#1
for
edible bean
production

North Dakota is ranked

#2
for
pea and lentil
production

North Dakota
produces nearly

40%
of U.S.
dry beans

North Dakota farmers
planted an estimated

265,000
acres of
lentils
in 2016

North Dakota farmers
planted an estimated

500,000
acres of
dry edible peas
in 2016

North Dakota farmers
planted an estimated

11,000
acres of
chickpeas
in 2016



The United Nations' Food and Agriculture Organization declared 2016 the International Year of Pulses and focused interest on pulse crop research programs, as well as the benefits of production and consumption of pulses worldwide.

Pulses, a subgroup of legumes, are crop plant members of the Leguminosae family (commonly known as the pea family) that produce edible seeds, which are used for human and animal consumption.

Pulse crops, including dry peas, lentils and chickpeas, are among the oldest cultivated plants, going back some 10,000 years.

Pulses are an important food crop that can play a major role in addressing future global food security and environmental challenges, as well as contributing to healthful diets.

Pulses are linked to:

- Food security because they are a critical and inexpensive source of plant-based protein, vitamins and minerals
- Human health because their consumption can prevent and help manage obesity, diabetes and coronary conditions
- Sustainable agriculture because they are able to biologically fix nitrogen and free soil-bound phosphorus



2016 NDSU Pulse Program Highlights

The fully integrated pulse program at NDSU includes two dedicated breeding programs and a pulse quality research program, which is unique in the U.S.

North Dakota Agricultural Experiment Station scientists on campus and at Research Extension Centers are involved in cutting-edge research on pulse production and end use.

End Quality and Utilization

Quality evaluations are completed annually by the Pulse Quality and Utilization Laboratory led by Clifford Hall, NDSU Plant Sciences Department professor.

“Our research is focused on assessing the chemistry, processing and nontraditional uses of raw pulses,” says Hall.

Current projects include improving the taste of pea flour for gluten-free foods, using pea proteins to replace eggs in bakery products, utilizing pea proteins in protein drinks and comparing edible bean cotyledon and whole-bean flours in food products.

Addressing Disease Management

Addressing disease management problems in lentils, field peas, chickpeas and dry beans has been a focus of Michael Wunsch, plant pathologist at the Carrington Research Extension Center (CREC).

His current research includes studies to improve the management of root rots and bacterial blight of field peas and to optimize the use of fungicides for reduced losses to root and foliar diseases.

“Pulse pathology projects are rewarding when they result in the identification of disease management strategies,” says Wunsch.

“Helping pulse producers reduce losses due to crop disease and improving the profitability of agriculture in North Dakota is the most rewarding part of my job.”

Better Weed Control

Conventional lentil cultivars have no labeled herbicides that will control broadleaf weeds once the crop has emerged. New research at the North Central Research Extension Center (NCREC) in Minot aims to study how lentils respond and tolerate pre-emergent herbicides to better control weeds, particularly kochia and wild buckwheat.

Brian Jenks, NCREC weed scientist, and Thomas Stefaniak, NCREC assistant pulse crop breeder, along with a team of research specialists, have worked to find lentil genotypes that can tolerate pre-emergent applications of sulfentrazone for better weed control. While some lentil genotypes have been promising, research is continuing.

Nitrogen Benefits of Faba Bean

Faba bean, an emerging legume crop in North Dakota, is being tested in the cooler and moister areas of the state.

Faba beans are the highest nitrogen-fixing legume in the world and can contribute 65 pounds of nitrogen to the soil for the next year's crop, based on a 50-bushel-per-acre yield.

“This potential cash crop provides growers with a win-win situation by reducing nitrogen fertilizer costs, while providing a 15 to 20 percent yield increase in crops grown the following growing season,” says Randy Mehlhoff, Langdon Research Extension Center (LREC) director.

Yield plots tested at the CREC, NCREC and LREC yielded more than 80 bushels per acre, with more than 90 bushels per acre recorded at the LREC.

Faba bean research and variety trials are ongoing.

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New Crop Varieties Offer Opportunities

Plant breeding is the art and science of combining the favorable genes for disease resistance, agronomic performance and end-use quality into a single plant to produce improved varieties. Plant breeding can be accomplished through many different techniques, ranging from selecting plants with desirable traits for propagation to new and emerging biotechnology methods that don't require the use of genetic transformation.

Developing a new plant variety takes a decade or more to accomplish. It starts with a need to improve a current variety. Through the use of traditional breeding, and after countless test trials across multiple years, a new variety becomes available for farmers to grow.

The North Dakota Agricultural Experiment Station (NDAES) released three new crop varieties in 2016: ND Bison soybean, ND Dylan rye and ND Palomino slow-darkening pinto bean. All three of these varieties were developed using traditional breeding methods.

ND Bison

ND Bison is a conventional soybean variety and is intended to be a replacement for Sheyenne. ND Bison matures one day earlier and is similar in yield to Sheyenne. ND Bison has improved defensive traits, including moderate resistance to soybean cyst nematode and to races 3 and 4 of phytophthora root rot.

ND Bison performed very well in the multistate uniform region test, which included testing sites in southern Minnesota and Canada. Development of ND Bison was made possible with funds provided by the North Dakota Soybean Council.

ND Dylan

ND Dylan is a high-yielding winter rye variety that has good winter hardiness. ND Dylan is the first new rye variety in the region in more than 20 years.

Data gathered from multiple years indicate a yield advantage over current commercial varieties. ND Dylan is a medium- to late-maturing variety, and heads out one day later than Rymin and five days earlier than Dacold.

The renewed interest in winter rye as a grain, cover or forage crop illustrates the need for a reliable source of adapted seed. Developed by Steve Zwinger at the Carrington Research Extension Center, ND Dylan was named for his late son Dylan Zwinger, someone who loved the land.

ND Palomino

ND Palomino is a slow-darkening pinto bean released jointly by the NDAES and the U.S. Department of Agriculture – Agricultural Research Service. ND Palomino offers the slow-darkening trait and competitive agronomic performance.

ND Palomino also offers an upright plant architecture, matures in approximately 102 days and is resistant to bean common mosaic virus. Agronomic performance, and seed color, size and shape are within acceptable commercial ranges of popular pinto bean cultivars grown in North Dakota.

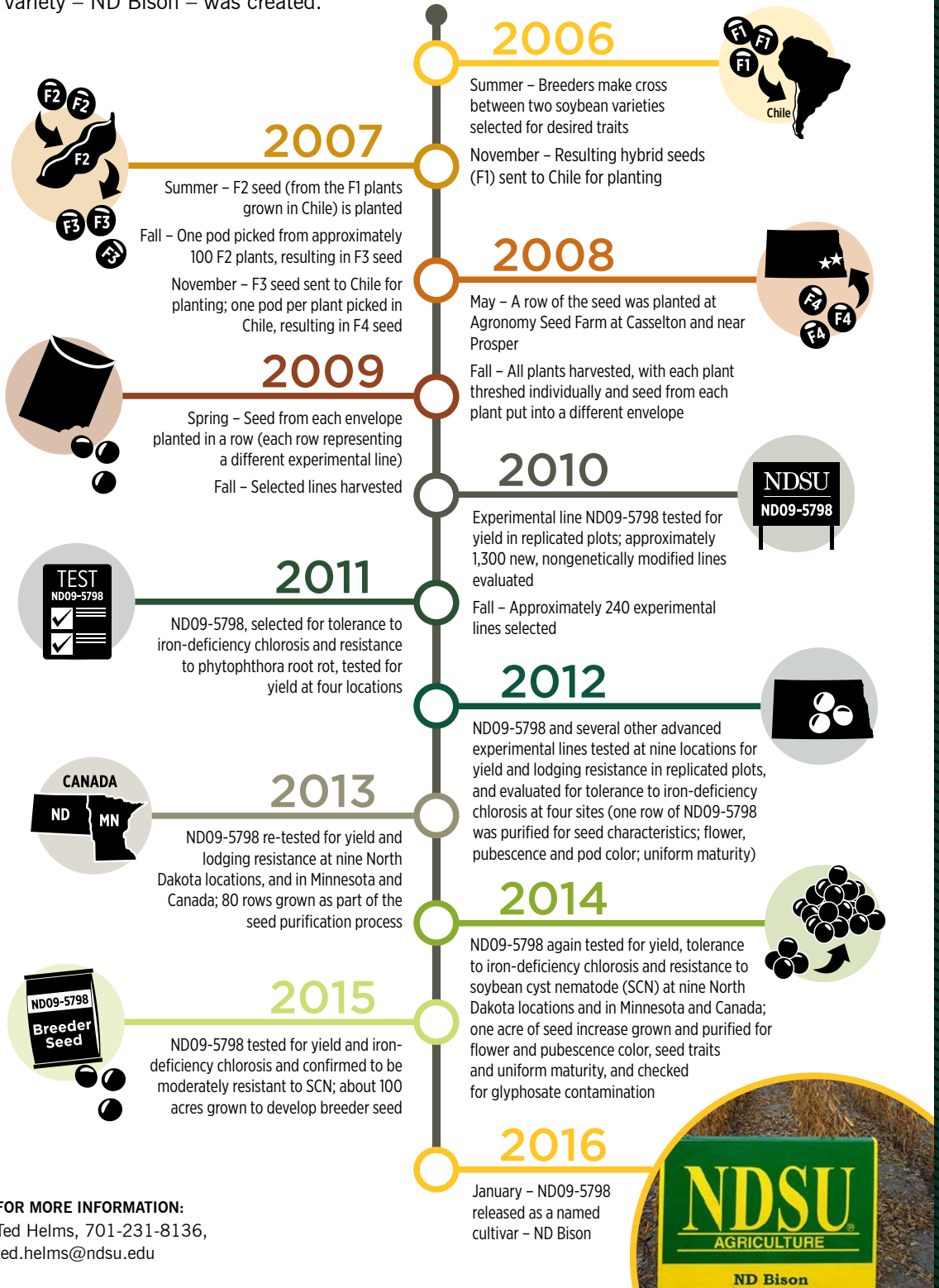
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From Start to Finish: Developing a Crop Variety

Here is a look at how the newest soybean variety – ND Bison – was created.



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Research Takes Aim at Weeds From the Air

North Dakota Agricultural Experiment Station scientists and Extension specialists collaborated with Sentera, a Minnesota company that designs sensors, unmanned aircraft systems (UAS) and software technology, to demonstrate that sensors mounted on manned and unmanned aircraft systems can identify weed infestations efficiently and effectively.

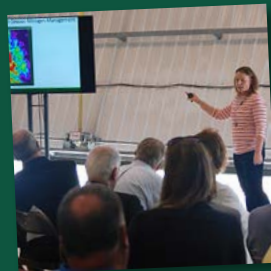
The project involved comparing images collected by UAS-mounted sensors with data from hand-held radio spectrometers and color, thermal and infrared sensors. The data was gathered on weeds in NDSU greenhouses and commercial crop fields, and at the NDSU Carrington Research Extension Center and Prosper research site.

Kochia, wild buckwheat, green foxtail, wild oats and Canada thistle were the focus of this study.

This research helps producers spot weed problems early in the growing season, select the proper herbicide and apply it on crops at the right time.

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Large-scale UAS Provides Valuable Ag Information

High-resolution imagery from a large-scale unmanned aircraft system (UAS) is a win-win for the agriculture industry, contends Sarah Lovas, a crop consultant and agronomy manager for her family's farm near Hillsboro.

The farm was in the flight path of a Hermes 450, a UAS with a 35-foot wingspan. The UAS collected data on crop stand counts, nitrogen effectiveness, iron chlorosis deficiency and crop yields, and inventoried pastured cattle at altitudes of 3,000 to 8,000 feet throughout the 2016 growing season. Elbit Systems Ltd. of Israel provided the UAS for a project North Dakota Agricultural Experiment Station scientists and Extension specialists launched to determine the usefulness of large-scale UAS in crop and livestock production.

The researchers compared the Hermes 450's imagery with data gathered by small UAS, satellites, in-field observations, on-the-ground sensors and soil analyses.

"This research is the first of its kind in the nation," notes Sreekala Bajwa, a project scientist and NDSU's Agricultural and Biosystems Engineering Department chair.

Lovas says the Hermes 450's imagery can help:

- Crop scouts target their efforts in trouble spots
- Producers more precisely monitor crop growth and dry areas in fields
- Pinpoint where crops need fertilizer or other agricultural chemicals

"At the end of the day, that will help farmers be more productive," she notes.

Adding UAS technology to the precision agriculture toolbox is important because, while the world's population is growing, available farmland is shrinking, says John Nowatzki, Extension agricultural machine systems specialist, who spearheaded the project.

Others involved in the project included technicians from Elbit's subsidiary, Elbit Systems of America, Fort Worth, Texas, to assemble the Hermes 450; personnel from the University of North Dakota's Center for Unmanned Aircraft Systems Research, Education and Training to fly it; and Civil Air Patrol pilots to fly a chase plane to monitor it in flight.

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Also see story on Page 24.





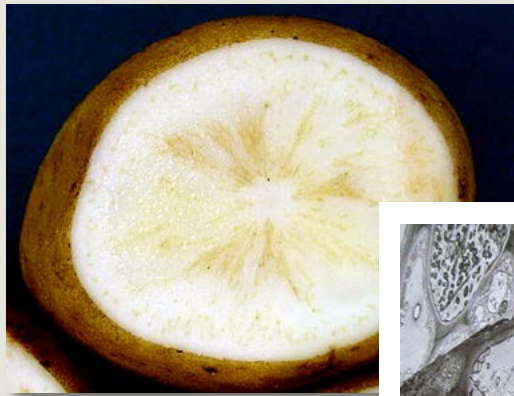
Neil C. Gudmestad,
Neil C. Gudmestad Endowed Chair
of Potato Pathology



William Wilson, CHS Chair in
Risk Management and Trading

Large gifts have established two endowed chair positions in the College of Agriculture, Food Systems, and Natural Resources – the first positions of their kind for NDSU. An endowed chair is a position permanently paid for with the revenue from an endowment fund specifically set up for that purpose.

“The endowed chairs will provide strong support for the important, highly visible potato pathology program and the risk and trade program established by Neil C. Gudmestad and Bill Wilson, respectively,” says Ken Grafton, NDSU’s vice president for Agricultural Affairs, director of the NDAES and dean of the College of Agriculture, Food Systems, and Natural Resources. “The endowments will provide stable and long-lasting support for teaching, research and outreach. These two programs are highly successful, respected and needed by the region’s agricultural sector.”



NDSU Potato Pathologist Leads the Way in Zebra Chip Research

In 2002, a disease found in few other places in the world began cropping up in potato plants in the U.S. Named after the dark stripes it creates on cooked potatoes, the zebra chip pathogen is spread by the potato psyllid insect. This pathogen affects all market classes of potato plants, causing them to die four to six weeks after infection.

NDSU University Distinguished Professor and Endowed Chair of Plant Pathology Neil C. Gudmestad and his team of researchers and fellow pathologists have led the world in learning about the zebra chip bacterium’s variability, detection and biology.

His experience with the disease started more than 20 years ago, when Gudmestad and Gary Secor, NDSU Plant Pathology professor, first observed the pathogen in 1994 in Mexico. Later reported in Texas, it has since spread to New Mexico, Kansas, Nebraska, Colorado, California, Oregon, Washington and Idaho.

“It went from a minor disease to a major disease within a decade,” says Gudmestad. “It’s what invasive pathogens do when they get into a country and there is no natural resistance in a plant species such as a potato.”

While there are diverse ways to control potato psyllid insects that carry the bacterium, such as insecticides and delayed planting, the cost of control could be up to \$400 per acre for potato growers. Gudmestad notes that the cost of controlling zebra chip in the U.S. exceeds \$15 million annually.

“It has been my life’s work to develop effective potato disease management tactics that can be used by the entire potato industry to meet the needs of a constantly changing industry,” says Gudmestad. “My long-term goal is for this research project to be productive in helping the potato industry be profitable long after my impending retirement.”

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Meteorological Forecasts Aid Farmers in Decision Making

Weather almost always is a hot topic of conversation in most rural North Dakota coffee shops.

Questions such as “How much will it rain this week?” and “When is the first hard freeze going to happen?” seem to dominate the minds of many farmers when planting season begins or harvest is wrapping up.

NDSU’s Crop and Pest Report is trying to make answering those questions a bit easier through the addition of a weather forecast section.

Each issue contains information about insect and disease problems, pest alerts, integrated pest management strategies, pesticide updates, agronomy and fertility issues, horticulture problems, reports from the NDSU Plant Diagnostic Laboratory, NDSU Extension Service meetings and a weather outlook.

The report also contains regional reports on agronomic and pest issues, plus crop development updates from Research Extension Centers across the state.

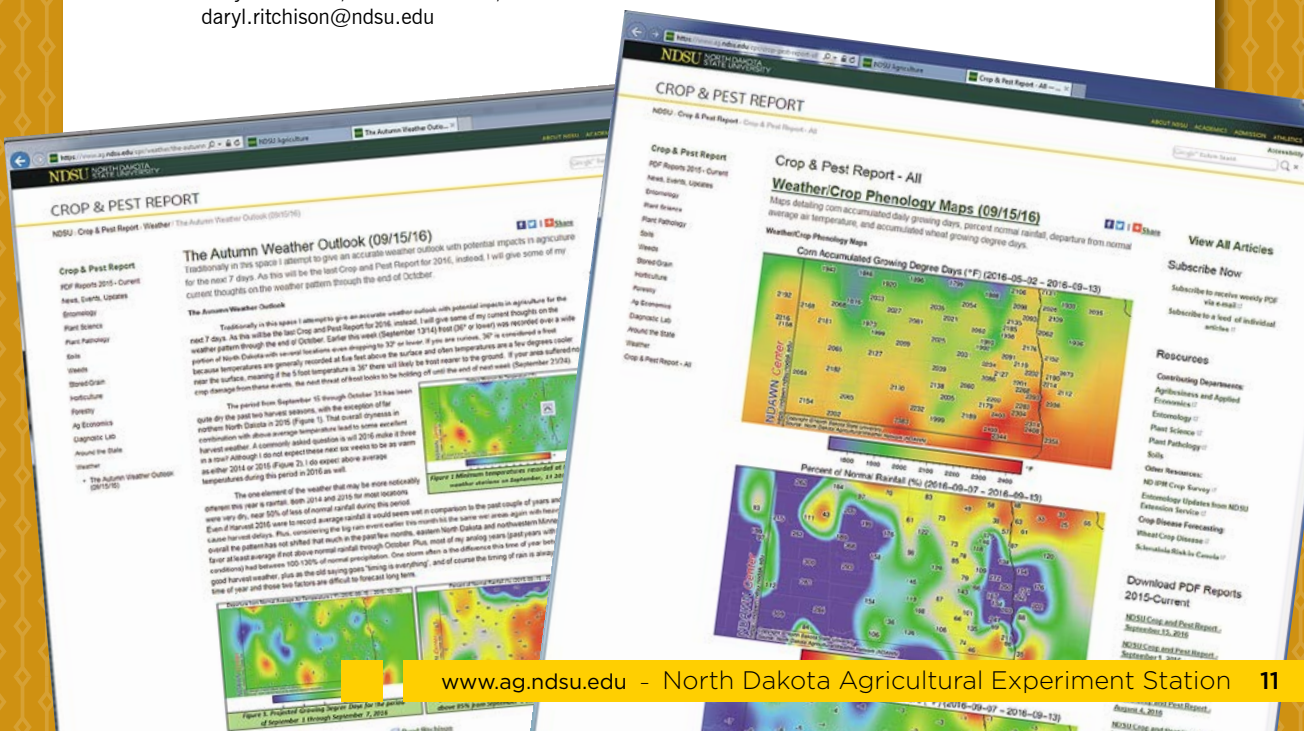
“While meteorology can be unpredictable, our job is to give North Dakota farmers the information and forecasts they need to make decisions about their operation,” says Daryl Ritchison, interim director of the North Dakota Agricultural Weather Network (NDAWN).

Ritchison adds, “Because the weather can significantly impact their bottom line, we also provide an array of tools through NDAWN, including current conditions, growing degree day models, soil moisture data, and even disease and insect forecasting services.”

The NDSU Crop and Pest Report received the Extension and Education Community Award at the American Society of Agronomy annual meeting.

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Scientists Study Beef Growth Promotants' Effect on Meat Tenderness

Anabolic implants and beta-adrenergic agonists (feed additives), which improve feedlot performance and carcass measurements, are the two most commonly used growth promotants in beef cattle production.

However, they appear to decrease the tenderness of the meat and turn the meat a darker color, making it less appealing to consumers, according to Kasey Maddock Carlin, a North Dakota Agricultural Experiment Station scientist.

Carlin, a technician and two NDSU graduate students collaborated with two faculty and two graduate students from Kansas State University on a research project to determine why tenderness decreases, what else happens in the muscle during growth and just how these growth promotants impact cattle and meat quality. Kansas State provided and fed the cattle, and conducted tenderness tests, and Carlin and her team analyzed the meat.

They used a unique approach that let them evaluate hundreds of muscle proteins at once instead of using traditional techniques that only allow for the evaluation of one or two proteins at a time.

“By using this approach, we were able to identify proteins that were either increased or decreased in abundance in the meat from cattle given growth promotants,” Carlin says. “These identified proteins have roles in muscle structure, energy utilization, growth and cell function.”

This effort to determine the mechanisms that cause the decrease in tenderness and color change will contribute to research that prevents these unpalatable consequences of making beef more efficiently, she adds.

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Finishing Diet Studies Can Save Cattle Producers Money

Research that North Dakota Agricultural Experiment Station scientists are conducting is helping beef cattle producers cut feed costs, which account for a large portion of cattle production expenses.

In research funded by the North Dakota Corn Council, the scientists found that including dried corn distillers grains with solubles (DDGS) in finishing diets for steers resulted in improved growth and feed efficiency, or the amount of feed required to produce a pound of gain. The scientists investigated adding DDGS, a byproduct of ethanol production, at two levels: 20 and 40 percent of the steers' diet dry matter.

The scientists also compared finely and coarsely dry-rolled corn in the diet. They discovered that increasing the fineness of dry-rolled corn before feeding it to the steers didn't have an impact on issues such as feed intake, growth and carcass characteristics such as fat thickness and rib-eye area.

In a related study, the scientists evaluated the effects of less oil in DDGS. The ethanol industry is removing more oil from distillers grains for other uses.

"The good news is we found no differences in growth performance for the different levels of oil," says Kendall Swanson, one of the scientists involved in this research. Scientists at the Beef Cattle Research Complex near campus and NDSU's Carrington Research Extension Center conducted the same research with the same results.

These findings mean that producers don't need to go to the expense of further processing dry-rolled corn before feeding it to their cattle, and they can take advantage of DDGS, a good feed source that's readily available in North Dakota.

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NDSU Researchers Dig Into Cattle Deaths

Research at NDSU is helping scientists, veterinarians and producers better understand a bacterium that can be fatal to cattle.

When 20 cattle died from neurologic disease in the spring of 2015, Veterinary Diagnostic Lab (VDL) staff and Teresa Bergholz, a Microbiological Sciences Department scientist, collaborated to learn what made the animals sick. They discovered the cause was bacteria called listeria monocytogenes.

“We do not typically see that many cases of listeriosis in cattle during the spring, and part of the reason for the research was to see if we could find something out about this group of cases that would give us a clue as to the increase in cattle cases,” VDL Director Neil Dyer says.

Listeriosis is a concern to producers because it has been linked to feeding cattle moldy or spoiled silage. North Dakota has about five cases a year.

Bergholz and an undergraduate student compared the various bacterial strains and sent the results to a worldwide database in France.

“We found some really interesting things,” Bergholz says. “We found two strains that are completely unique, that had never been seen before.”

They also discovered that three pairs of cows had the same strains even though the animals were hundreds of miles apart.

The long-term goal of this research is to develop a database of listeriosis cases in the state so researchers can identify trends, Bergholz says.

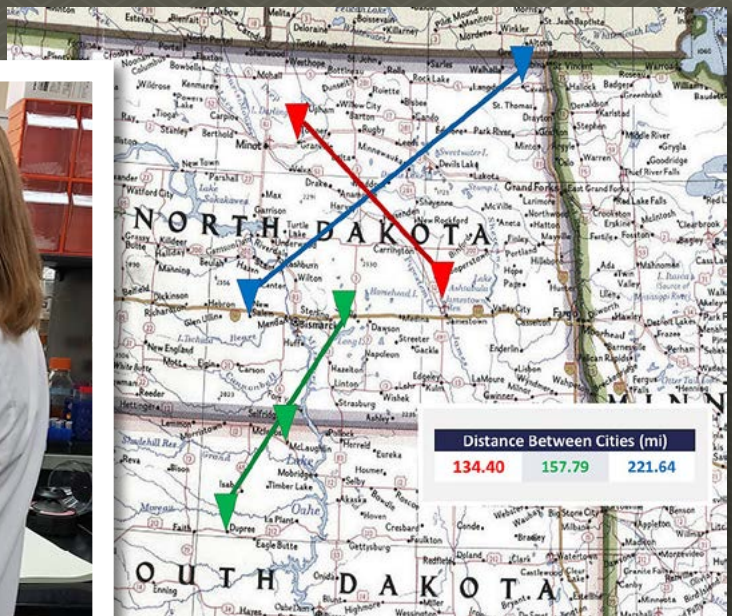
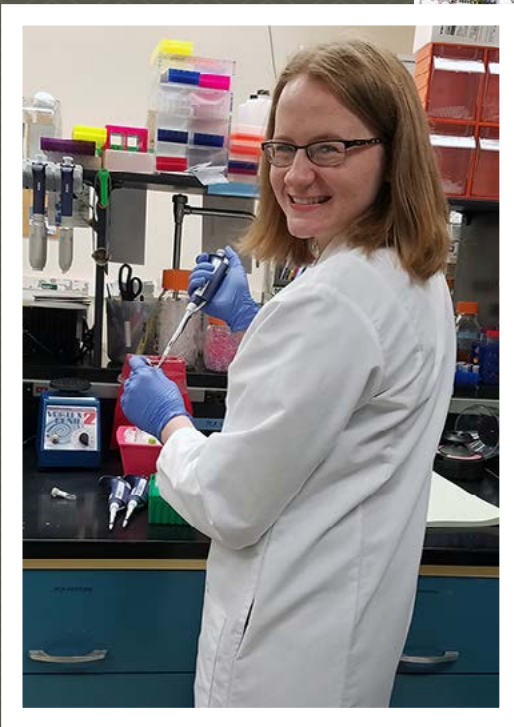
“The fact that we found unique strains and were able to identify pairs suggests some sort of a common link,” she adds.

She thinks the database also might help in determining whether the disease strains affecting cattle are the same ones that cause human illness.

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Vet Diagnostic Lab Construction on Schedule

Construction of the North Dakota Agricultural Experiment Station's new \$18 million Veterinary Diagnostic Laboratory began in March 2016 and is on schedule. With approximately 27,000 square feet, the one-story lab will be about double the size of the current facility. The new lab also will be better lighted and designed to handle a growing caseload. It will include a biosecurity level 3 suite to allow staff to work safely with diseases that can be passed between animals and humans. The new lab, funded with an appropriation from the 2015 state Legislature, is scheduled to be completed by the summer of 2017.



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6

years of research to understand the effect on soil salinity:

35

species of cover crops

12

varieties of alfalfa

3

species of legumes

11

perennial grasses

Research Shedding Light on Saline Soil Remediation

A study aimed at evaluating the use of perennial grasses, legumes and cover crops to remediate saline soil is giving North Dakota farmers hope for their salt-affected land.

Several factors contribute to the development of saline soils in North Dakota, but a high water table is a prime cause. Land use practices and rainfall patterns also have influenced the spread and severity of saline soil.

Ezra Aberle, research specialist at NDSU's Carrington Research Extension Center (CREC), has spent six years planting 35 species of cover crops, 12 varieties of alfalfa, three species of legumes and 11 perennial grasses into saline soil to understand their effect on soil salinity.

"Some species of cover crops grown under no-till served to stabilize soil salinity," says Aberle. "However, the perennial grasses have been able to lower the soil salinity, suggesting it could be possible to achieve remediation over time."

But Aberle cautions, "Total reclamation of saline soil is a long-term process. It took decades for some soils to become excessively saline, and it will take many more years to restore soil to its more natural state."

Blaine Schatz, research agronomist and director of the CREC, concludes that while the process of remediating saline soil takes time, he believes the whole team of agronomists and soil specialists who have worked on this study would agree that they are making a difference for farmers facing soil salinity issues.

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Oil, Biofuel Production Impacts Water Resources

Water is a vital resource, and activities such as oil, gas and agricultural production can impact its quantity and quality.

Scientists in NDSU's Agricultural and Biosystems Engineering Department have been studying those impacts. Here is what they found:

Western N.D. Oil Production

- From 2008 to 2014, the industrial water use for Bakken shale oil development accounted for 0.5 to 10 percent of North Dakota's annual water use.
- Temporary oilfield workers accounted for about 15 percent of the Bakken's annual industrial water use.
- The Bakken development's impact on the regional water supply was limited because the water was managed and the region received, on average, more than 20 percent more precipitation than normal for 2008-2014.

"Given that the use of hydraulic fracturing is still on the rise, the findings from this Bakken shale study will be of great importance to policymakers and communities in and around the hydraulic fracturing oil regions of the country," says Zhulu Lin, an assistant professor who led the research.

Cellulosic Feedstock Production

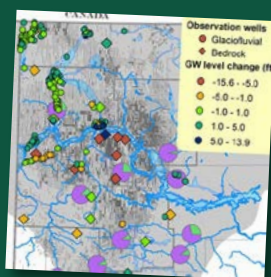
The Energy Independence and Security Act (EISA) of 2007 has led to an increase in crops grown for biofuel production and an expansion of agriculture into previously unsuitable or less fertile land, which could impact water sources. NDSU research shows the magnitude of the spring snowmelt peak flows in the Red River remained unaffected. However:

- Downstream flows had greater variability after the EISA went into effect, which may lead to greater uncertainty in predicting spring floods in the Red River Valley.
- Sediment and nutrients in the Red River Basin water at the U.S.-Canadian border increased post-EISA.

This research will help policymakers, producers and others better understand the benefits and/or consequences of meeting the EISA's goal of increasing biofuel production, Lin says.

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Research Leading to Stream Improvements

Miranda Meehan, an NDSU Animal Sciences Department scientist, is helping test an evaluation method that could become the North Dakota standard for assessing stream health.

Meehan teamed up with North Dakota Health Department, Natural Resources Conservation Service and Bowman-Slope Soil Conservation District personnel on the Little Missouri Assessment Project. They're determining the condition of intermittent streams in five Bowman County watersheds.

The objective is to identify streams that qualify for federal water quality enhancement grants. If the team's evaluation method is successful, Health Department officials plan to use it statewide. Meehan hopes she also can help livestock producers, resource managers and landowners better understand the ecosystems along streams so they can manage and/or restore the stream banks.

The team is gathering data on the streams' condition, including the state of the stream channel and risk of stream bank erosion. Team members also are collecting information on the land use and health

of adjacent uplands, and assessing soil conditions, water movement and health of the plant communities.

"It's a much better way to assess our watersheds," says Camie Janikowski, Bowman-Slope Soil Conservation District manager. "It's going to be more useful data."

So far, the team found that contrary to the accepted management practice of removing grazing livestock to protect stream banks, it has the opposite effect in Bowman County. Removing livestock or reducing the number of animals grazing along the banks has allowed smooth brome grass to flourish. This species has a shallow root system (3 feet), compared with native plant species (8 to 10 feet), which can lead to bank erosion and increased sediment loads in streams.

This is the first study of its kind for prairie streams. The team plans to complete the project in 2017.

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Extension is Extending Knowledge, Changing Lives

North Dakotans are helping shape the educational programs offered by the NDSU Extension Service.

More than 300 people attended 11 community forums Extension held across the state in the fall of 2015 to learn about North Dakotans' concerns on agriculture, the economy, energy, natural resources, children, family and communities.

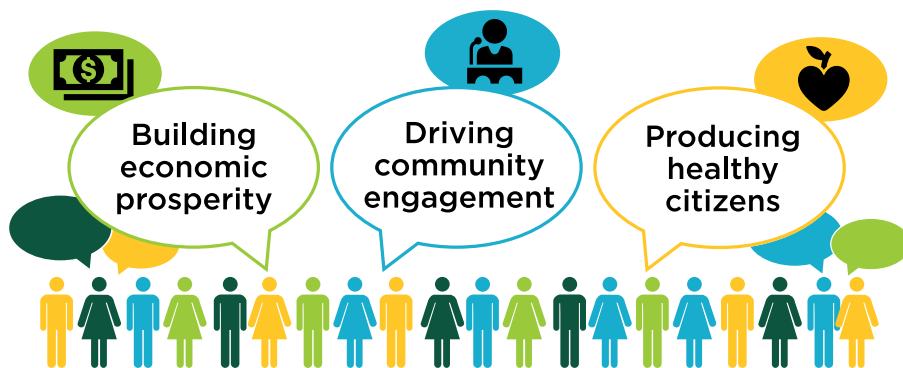
"NDSU Extension staff recognize that to be most effective, they need to listen to local stakeholders and regularly ask about crucial issues and challenges affecting each region," Extension Director Chris Boerboom says.

Input from the community forum participants will guide Extension's strategic planning efforts in the next three to five years. This information also helps Extension create programs that most strongly align with people's needs and priorities.

"I thought the community forum concept was great," says Hazelton Auditor Angie Benz, a forum attendee. "It allowed people to get their concerns out in a way that every person would be heard."

Extension responded by strengthening or developing a number of relevant programs in three key areas: building economic prosperity, driving community engagement and producing healthy citizens. Extension state and area specialists and county-based agents work collaboratively to deliver the programs.

The remaining articles in this report demonstrate the impact of Extension programming throughout the state.





Program Helps Producers and Gardeners Combat Pests, Weeds, Diseases

In North Dakota, decisions on controlling insect pests, weeds and crop diseases are an important and costly part of farming.

NDSU Extension's Integrated Pest Management (IPM) program gathers current pest information through six trained scouts working out of North Dakota's Research Extension Centers. The scouts regularly monitor fields throughout the growing season to detect insect pests and diseases, and determine where they're concentrated and the damage they've caused.

NDSU Extension's IPM program shares this information through:

- Weekly Crop and Pest Report (online and email)
- Producer meetings, Research Extension Center field days and other educational events
- Extension specialists' and agents' news releases, columns and radio programs, social media and consultation
- Forecasting models that help producers determine pest or disease risks and when to take control measures

Extension agents and specialists also provide producers, gardeners and homeowners with control strategies aimed at reducing pesticide and herbicide

resistance, and protecting the environment and beneficial insects or pathogens.

When Finley homeowner Dennis Lindstrom brought a mud nest into Extension's Steele County office in Finley, Angie Johnson, agriculture and natural resources agent, worked with Janet Knodel, Extension entomologist, to identify it as a mud dauber (a kind of wasp) nest.

"The word 'wasp' directly places fear in the homeowner's eyes," Johnson says. "However, the mud dauber wasp is a beneficial insect as it is not your typical stinging wasp. With correct identification, we were able to prevent the homeowner from applying an insecticide to the wasp nest."

Producers play a role in this collaborative effort, too. For example, when Emerado-area farmer Jared Hagert found he had a soybean aphid problem year after year, he began hosting NDSU research trials on his farm.

"I feel it's important to provide some access to real-world growing conditions for research," he says.

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Extension Shares Sustainable Ag Strategies

Cover crop demonstration projects are one way NDSU Extension is helping producers learn more about sustainable agricultural practices.

“We’ve explored a lot of different strategies in using cover crops,” says Brad Brummond, the Extension agriculture and natural resources agent for Walsh County. Those strategies include planting cover crops in saline areas or fields with excess moisture, and following the wheat harvest, as well as planting different cover crop mixes and grazing cover crops.

“We’ve also looked at it from strictly a soil quality standpoint,” Brummond says of the demonstration projects.

“We need to become more sustainable,” he adds. “We have to evolve our farming systems into systems that are profitable, into systems that produce quality food at lower costs and leave a smaller footprint on the environment.”

Producer Justin Zahradka helped launch the demonstration projects in Walsh County.

“I’ve been able to show you can increase yields following planting of a cover crop because it retains and recycles nutrients that you otherwise might lose,” Zahradka says.

“We’ve proven you can grow two crops in one year in Walsh County,” Brummond says. “That’s pretty groundbreaking this far north.”

Zahradka also found that cover crops benefit livestock, with his yearling calves gaining an average of 2 pounds per day on cover crops, almost double what the calves gained on native pasture.

Brummond also specializes in organic production and is the primary NDSU Extension contact for organic issues. He works with organic and sustainable producers in North Dakota and South Dakota.

“That is one of my great success stories,” says Brummond, who was named the North Central Region Sustainable Agriculture Research and Education (NCR-SARE) program’s 2016 NCR-SARE Hero. He has been instrumental in the organic industry’s development in North Dakota.

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BQA Program Improves Beef Quality, Consumer Confidence

The first time Berthold-area cow-calf producer Gail Yuly received 4 cents more per pound for cattle she sold because they were beef quality assurance (BQA)-certified, she was amazed.

She immediately called Lisa Pederson, NDSU Extension's BQA specialist, with the good news.

"Lisa said that would happen when I got into the BQA program," says Yuly, one of more than 1,900 North Dakota BQA-certified cattle producers.

BQA is a national producer-driven program. In North Dakota, it's a collaborative effort of NDSU Extension and the North Dakota Beef Commission. It helps cattle producers improve their management practices so they provide healthful, high-quality beef free from defects such as injection-site lesions and bruises. This increases the cattle's market value while instilling consumer confidence in the beef industry.

Working with Extension agents, veterinarians and allied industry personnel such as feed dealers, Pederson also educates producers about the importance of better genetics and nutrition, protecting their cattle through herd health practices and implementing better cattle-handling techniques.

Doug Bichler, who has a cow-calf and seedstock operation near Linton, discovered that improved cattle-handling can be as simple as learning the best way to approach cattle or patching a hole so cattle aren't distracted by light as they pass through a chute.

"It's been a real help to try to understand how cattle think," he says.

Pederson works with dairy producers as well, helping them understand they are a valuable part of the beef industry and educating them about practices to improve their value to the industry.

"She gives you confidence," Linton-area dairy producer Rita Mosset says of Pederson.

Pederson also led the development of a program to train emergency responders how to handle traffic accident scenes involving livestock.

In recognition for her work, Pederson received the 2016 National Beef Quality Assurance Educator of the Year Award.

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Photo courtesy Trevor Graff, North Dakota Stockmen's Association





Agents Play Key Role in UAS Project

When Extension agents Alyssa Scheve from Traill County and Angie Johnson from Steele County learned a large-scale unmanned aerial system (UAS) would fly over their counties during the 2016 growing season for an NDSU research project, they immediately began notifying the affected landowners.

Johnson and Scheve organized informational meetings in both counties and spoke at township officers meetings about the project, which was to determine the usefulness of large-scale UAS in crop and livestock production. They also sent letters to the more than 500 landowners in the project's four- by 40-mile corridor and placed ads in local newspapers about the meetings.

During the meetings, the agents facilitated discussions on data collection, storage and privacy, assuring landowners that the data are stored on a computer at NDSU and those accessing the information must have a password.

"They really were the key," John Nowatzki, Extension agricultural machine systems specialist and project leader, says of the agents. "We needed to make sure we got the word out about what we were doing."

The agents also fielded numerous inquiries from landowners and others who heard about the project or saw the UAS. In addition, Scheve heard from people in other states who are interested in the project.

"This type of precision agriculture is on the forefront of producers' minds for another farm management tool," Scheve notes.

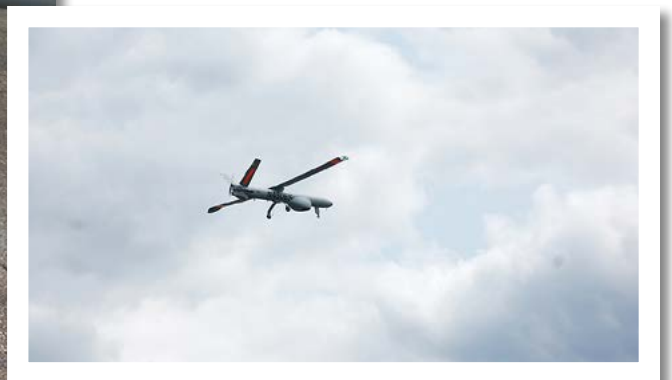
"Right now, as Extension agents, we are turning our focus to how to use the imagery to help producers make management decisions in their fields and/or livestock operation, and ultimately to save them time and money," Johnson says. "We still have a lot to learn from this project, but this really would not have happened without the support of our Traill and Steele County landowners and producers."

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Also see story on Page 9.





Livestock Environmental Stewardship Program Helps Producers Manage Livestock and Land

Stewardship is defined as the responsible and careful management of something entrusted to one's care.

Created in 2011 by an initiative in the North Dakota Legislature, the NDSU Livestock and Environmental Stewardship program focuses on research and Extension education to broaden the knowledge of livestock producers on livestock and environmental interactions, sustainability and producing animal products for a world with a rapidly growing population.

“Our mission is to conduct research and develop educational materials to meet the needs of North Dakota livestock producers,” says Gerald Stokka, NDSU Animal Sciences Department associate professor and Extension livestock stewardship specialist.

Miranda Meehan joined the stewardship team in 2015 as NDSU Extension’s first livestock environmental stewardship specialist.

Meehan and Stokka’s research and livestock stewardship educational programs include:

- Understanding the veterinary feed directive
- Determining carrying capacity and stocking rates for range and pasture in North Dakota
- The North Dakota Grazing Monitoring Stick: A way to measure range and pasture utilization
- Livestock water quality
- Animal health
- Animal handling
- Public perception and today’s livestock industry: Bridging the knowledge gap

“My job is to help livestock producers and land managers understand their responsibility to manage livestock, land and natural resources in a sustainable manner,” says Meehan. “This ensures that their resources and lifestyle are preserved for future generations.”

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Farm Management Tools Aid in Complex Decisions

North Dakota producers have found NDSU Extension’s farm management and planning tools helpful in making decisions about everything from planting to farm bill program enrollment.

“There are some decisions producers have to make, and we’ve put out analysis tools to help them through that process,” says Andrew Swenson, Extension farm and family resource management specialist. “We try to make it easy to use. I think we’ve succeeded in that. We can focus on just the crops North Dakota grows and the decisions we know our producers will have to make.”

Those tools include annual crop budgets. Extension specialists develop the budgets annually for nine regions in the state in PDF format or as an Excel spreadsheet in which producers can input their own numbers. Budgets for up to 18 different crops project revenues based on projected yields and prices, along with line-item costs. Producers can complete a whole-farm cash-flow scenario using the budgets.

Ag processors and financial institutions also have found the information useful.

“I use it every spring when we’re sitting down to do our budgets and cash flows,” says Merlyn Sem, assistant vice president at Liberty State Bank in Powers Lake. “I’m glad to have it, and it’s free.”

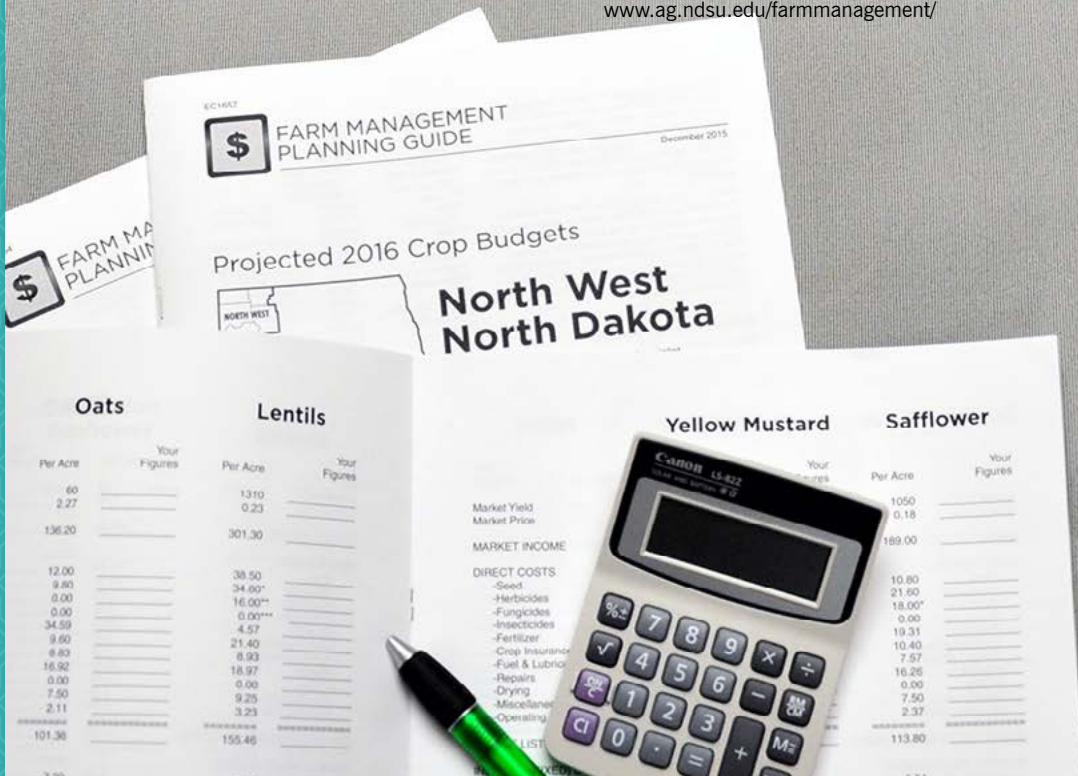
He also says having crop value projections from a reputable source is helpful.

Other Extension-developed farm management tools include:

- Crop Compare – Producers enter the price for one crop and the tool will show what the price must be for all the other crops to generate the same return.
- Prevent planting analysis – This helps producers make decisions about whether to plant during a late spring.
- Farm bill calculator – It helps producers with their sign-up decisions.

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Local Foods Efforts Connect Producers and Consumers

Farmers are experts in growing fruits and vegetables, but they often struggle with marketing their produce and making a profit.

Some consumers are interested in eating locally grown food but know little of what that means. Other consumers might know about local foods but have no access to affordable fresh produce.

The NDSU Extension Service is helping bridge those gaps through education.

Agents provide soil analyses to let producers know what crops will be the most productive, help them find financial and other resources to market their produce locally, and assist with starting farmers markets and community gardens.

Community gardens can provide numerous people with healthful food. For instance, Carrington's community gardeners donate produce to the senior citizens center, food pantry and school hot lunch program.

Local foods efforts have other benefits, too. Community gardens and Barter Markets in Sioux County increase family participation, community and youth engagement, and a sense of community, says Sue Isbell, an Extension agent.

Glenn Muske, Extension's rural and agribusiness enterprise development specialist, helps farmers understand what kinds of crops or operations might be the most profitable, identify potential markets and learn how to use traditional and social media to reach potential customers.

Muske has connected someone wanting to start an energy-efficient greenhouse with NDSU agricultural engineering and architectural experts, and advised growers on operations such as you-pick farms and community-supported agriculture (CSA) ventures.

CSAs, which let members share in a local farm's harvest, are a great way to inform consumers about the challenges producers face, he says. For instance, when hail wiped out some of a Bismarck-area CSA's crops, the farmer warned members not to expect certain vegetables.

"It's putting a real face on agriculture," Muske says.

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Citizens Learn to Lead, Strengthen the Economy

Positive changes happen in communities when adults and youth become leaders and volunteers, but people often don't feel qualified to take on that role.

To help citizens feel more prepared to serve as effective board, council or committee members, specialists in NDSU Extension's Center for Community Vitality developed Lead Local, a fun, interactive one-day program.

"We're trying to give them confidence," Center Director Lynette Flage says.

Participants learn about ethics, open-meeting laws, parliamentary procedure and dealing with conflict.

"I had been thinking of running for City Council for some time, and after taking the Lead Local program, it really gave me that extra confidence to move forward with that decision," Lacey Hinkle of Cavalier says. "The process of running for and winning the City Council seat was a great experience, and I'm using the tools from Lead Local to help me be the best representative I can be."

Nearly 120 people, including county commissioners, legislators, city council members, township officers and agricultural producers, have attended one of seven

Lead Local sessions held so far. Almost 92 percent report feeling better prepared to serve on a board.

Communities also often struggle with strengthening their economy. To assist them, Extension partnered with USDA Rural Development on the Stronger Economies Together (SET) program. The idea is for communities to work collaboratively on an economic development plan that builds on the region's current and emerging economic strengths.

As a result, community and business leaders in Logan, McIntosh and Emmons counties are looking at ways to combine their efforts to increase tourism, improve access to local foods and health care, and get more youth involved in leadership roles.

To improve young people's engagement, Extension launched Lead Local for Youth this fall.

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Almost
92%
of Lead Local participants
feel better prepared to
**serve on a
board**



4-H Teaches Real-life Skills

As public affairs director for Odney, an advertising and marketing firm in Bismarck, Shane Goettle knows the importance of communicating effectively.

He credits 4-H for setting him on the right path.

Goettle showed beef and sheep during Mountrail County 4-H achievement days and the State Fair, attended 4-H livestock and conservation camps, and was involved in leather crafts, welding, woodworking, speech and demonstration, and livestock judging.

“It helped enormously in terms of my communication skills,” he says of the speech and demonstration projects.

Goettle found livestock judging also was a great learning experience. It requires youth to evaluate and rank classes of animals and provide oral reasons for their decisions.



“It helped me develop some incredible life skills,” he says.

He adds that working with animals also taught him valuable characteristics such as persistence and patience, which have served him well throughout his career.

For Lynn Paulson, senior vice president and director of agribusiness development at Bell Bank in Fargo, the nine or 10 years he spent in 4-H in Benson County taking care of and showing livestock and being involved in livestock judging instilled confidence in him, which has been very useful in his job. He often speaks to financial, commodity and other farm groups on agricultural lending and finance, and the global and agricultural economy.

Participation in a 4-H club also taught him leadership skills.

“I learned how to run a meeting and listen to different sides of an issue in a respectful way,” he says.

Goettle and Paulson are two of thousands of examples of 4-H’s impact. Research shows that youth involved in 4-H do better in school, help others in the community, and are more likely to continue engaging in leadership and community-related activities after leaving 4-H than those enrolled in other youth organizations.

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4-H Ag and Livestock Projects Stay Popular



Shooting sports is one of North Dakota's fastest-growing 4-H programs, but agriculture and livestock programs remain among the most popular.

"I think kids get involved in the ag and livestock part of 4-H more because they've grown up with it, and they're very interested in seeing the different parts of the ag-related things and learning about different animals that they might not have on their farm," suggests Kidder County 4-H'er Michelle Fitterer. She shows beef cattle and rabbits, and is involved in livestock, dairy and range judging.

"We're still an ag-based state, and 4-H allows a lot of kids to have livestock and have a project with animals," says Penny Nester, NDSU Extension's agriculture and natural resources agent in Kidder County.

"With 4-H, you can raise and show livestock, even if you live in town," Adams County 4-H'er Kaden Schauer says. "In our

town, we are lucky to have a wonderful man donate the facilities of an old stockyard to house livestock for those who have no other place to house them."

The opportunity to learn attracts a lot of youth.

"With being able to show in 4-H as early as 8 years, it gives members a great head start if they are interested in learning about animals," Schauer says. "Through the process of raising livestock, we learn the costs of raising them, feeding them and showing them."

These programs also remain strong because of family tradition, and youth can develop a relationship with an animal, share a common interest and engage in competition with other youth, and realize a sense of accomplishment, according to Dean Aakre, Extension 4-H youth development specialist.

"I think people like to see things grow," he says. "That fits animals and plants."

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Number of 4-H members enrolled in animal projects 2015-16:



1,191
beef



150
dairy



551
goat



1,067
horse



783
pets



594
poultry



677
rabbit



566
sheep

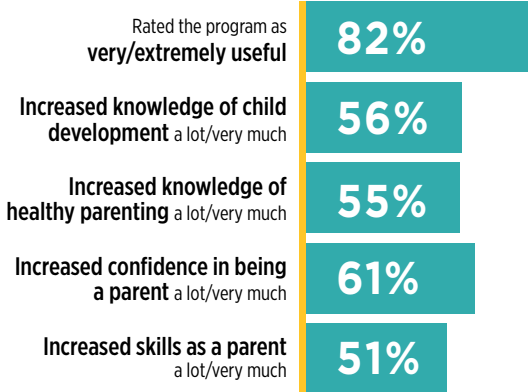


552
swine

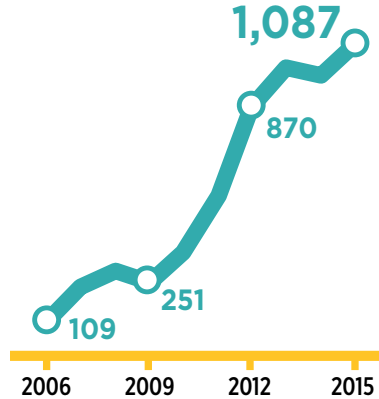




**Gearing Up for Kindergarten
Impacts on Parents, 2006-2016**



N.D. Families Participating in Gearing Up for Kindergarten, 2006-2016



Parents Get Geared Up for Kindergarten

Fargoans Ben and Scarlet Bernard were worried about what would happen when their older son, Perrin, started kindergarten in 2015.

Perrin had been diagnosed with Asperger’s syndrome, a form of autism. His parents weren’t sure how he would react. Then the Bernards learned about NDSU Extension’s Gearing Up for Kindergarten (GUFK) program.

GUFK is a multiweek program to help all parents and their children with the transition to kindergarten. Children learn school readiness skills, such as playing with others and taking turns, sensory and motor development, reading, math and science, while parents learn about parenting styles, children’s learning styles, brain development and discipline.

“Perrin had a fantastic kindergarten year,” Ben Bernard says. “I do feel Gearing Up for Kindergarten was a positive influence on my parenting skills and my son’s readiness for kindergarten.”

Bernard especially appreciated being able to bring his younger son, Ian, now a kindergartner, with him and Perrin to the school where the GUFK classes were held. Ian received child care while Bernard and Perrin

were in sessions, and Bernard involved Ian in the GUFK take-home activities.

“There was a huge value in being able to give my boys a pre-kindergarten experience in an actual elementary school setting with actual kindergarten teachers,” Bernard says.

GUFK also helped him realize that today’s children need to be much better prepared than when he attended kindergarten, and he could meet the children who would be his boys’ classmates and their parents.

GUFK is invaluable for educators, too.

“I can’t say enough about what the program has done for our students and their readiness for kindergarten,” says Surrey Elementary School Principal Debbie Hansen.

Research indicates basic academic and social skills are three times higher among children who complete GUFK. The program also is very cost-effective: \$350 per student vs. \$1,350 for remediation later.

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After participating in Family and Consumer Science programs:

Family and Consumer Sciences Programs Making Huge Impact

Health and wellness are among North Dakota's biggest challenges.

To help ensure the state has healthy people and communities, NDSU Extension's family and consumer sciences (FCS) programs focus on three key areas: family finance, human development and family science, and nutrition, food safety and health. They are making a difference:

- **Family Nutrition Program** — 63 percent of adults in the program are spending their food budget more wisely.
- **Expanded Food and Nutrition Education Program** — Participants improved at least one nutrition practice (83 percent) and one food safety practice (47 percent).

Leslie Carlson of Rolette County signed up for the Nourishing Boomers and Beyond program because she, like many adults 50 and older, is concerned about keeping her family healthy. Now she includes vegetables in the lunches she packs for her husband and his brother.

Youth nutrition education and programs for older adults also make a substantial impact:

- **Banking on Strong Bones** — Fewer youth choose soda pop instead of milk (dropped from 36 to 25 percent).
- **On the Move to Better Health** — 62 percent of youth increased their daily physical activity, 58 percent chose more healthful snacks and 54 percent ate more fruit and vegetables.
- **Stepping On** (helps seniors stay in their homes and age in place) — 79 percent reduced falling hazards at home.

Donnybrook-area producer David Miller, who hopes to retire this year, found the Design Your Succession Plan program so helpful that he attended it twice.

"It gave me a road map to do what I want to do," he says.

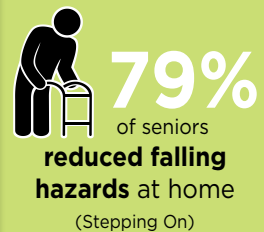
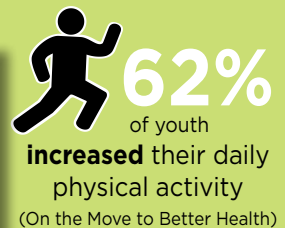
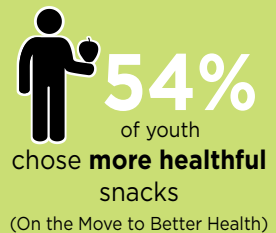
Although Extension is among several agencies addressing health-related, financial or environmental problems, it does not duplicate the others' efforts.

"The NDSU Extension Service targets primary prevention education work," says Deb Gebeke, NDSU Extension's assistant director for FCS. "Social services and health organizations target intervention work."



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Youth, Adults Get Hands-on Lessons in Agriculture

Agriculture is North Dakota’s No. 1 industry, yet fewer and fewer youth and adults have been on a farm or know where food comes from and how it’s produced.

To help make those connections, NDSU Extension agents throughout the state hold programs for students such as Ag in the Gym, Bread in the Bag, Kids and Compost, Living Ag Classroom and Special Assignment: Pizza.

“We want our youth to realize that food actually comes from agriculture long before it arrives on grocery store shelves,” says Joel Lemer, Extension’s agriculture and natural resources agent for Foster County.

In Ag in the Gym and Special Assignment: Pizza, students rotate through booths or stations, where they learn about nutrition, crops, livestock and production practices. They also learn that North Dakota agricultural products are used in making something familiar: pizza.

“I had a lot of fun at the Special Assignment: Pizza field trip,” Minto fourth-grader Keira Anderson says. “I liked it when we played bingo, and I liked when we had to guess which food we were touching.”

Bread in the Bag lets students see how bread is made. Kids and Compost and Living Ag Classroom show how livestock manure can turn into a useful product (fertilizer) that becomes food for the plants that humans and livestock eat. The students also help make compost.

For adults, the Field to Fork webinar series provides information on safely growing, processing, preserving and transporting North Dakota-grown fruits and vegetables, including apples, dry beans, grapes, leafy greens and pumpkins. More than 450 people have attended the webinars, and about half of the 334 who completed surveys said they are changing production, processing, marketing or product use practices.

Extension also offers Garden to Table publications on growing and using vegetables such as potatoes, garlic and tomatoes, and preserving fruit.

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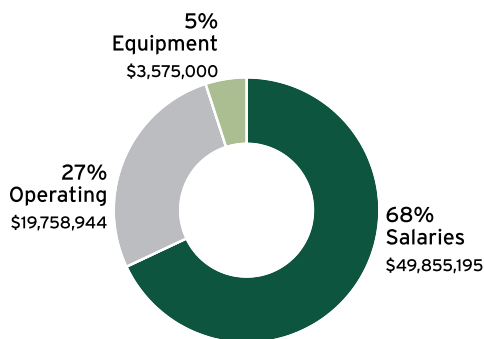
Year 2 Summary of 2015-2017 Biennium

2016-2017 Annual Budget Book – Authorization

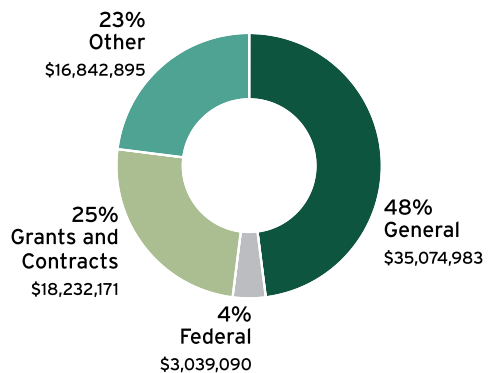
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■ North Dakota Agricultural Experiment Station

Budgeted Expenses

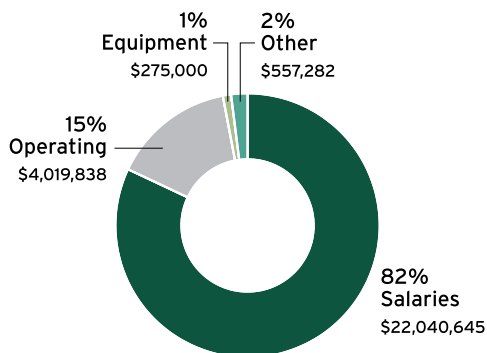


Funding Source

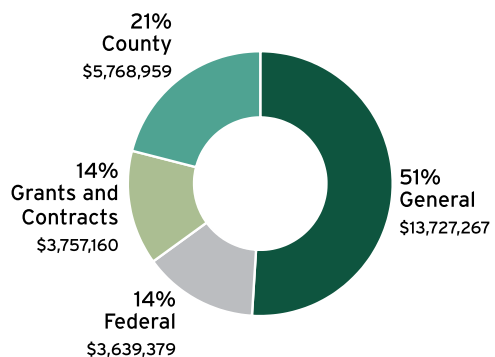


■ NDSU Extension Service

Budgeted Expenses



Funding Source



NDSU

Agricultural Affairs

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Agriculture and Extension at North Dakota State University

The North Dakota Agricultural Experiment Station consists of seven Research Extension Centers placed strategically throughout the state and the Main Station in Fargo. We work to develop techniques and technologies to enhance the production and use of food, feed, fiber and fuel from crop and livestock enterprises.

The NDSU Extension Service provides the people of North Dakota with the research-based information they need to succeed in today's increasingly complex world and be prepared for the future. We have offices serving all of North Dakota's 53 counties and Fort Berthold.

NDSU NORTH DAKOTA STATE UNIVERSITY

If you would like more information on the programs in this publication, contact the faculty and staff listed. If you would like more information about our other programs or have questions, comments or suggestions, please contact one of us.

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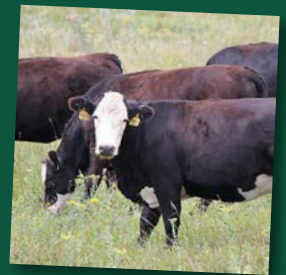
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