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Strategic Discussions for Nebraska: Opportunities for Nebraska -- Food Scarcity

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STRATEGIC DISCUSSIONS FOR NEBRASKA

Opportunities for Nebraska: Food Scarcity

IANR

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"Our mission is to be the people's university and to put the best scholarship and the best education and the best research and the best outreach toward improving our state."

– IANR Vice Chancellor and NU Vice President Ronnie Green

The Morrill Act of 1862

On July 2, 1862, President Abraham Lincoln signed into law a bill that donated land to each state for the establishment of colleges to provide a liberal and practical education to the "industrial class," or the common person. These colleges would provide instruction in agriculture and the mechanic arts, such as engineering. Because of the land granted to each state and territory, the Morrill Act of 1862 became known as the land-grant act.

Sponsored by U.S. Congressman Justin Smith Morrill of Vermont, the bill allotted 30,000 acres of public land for each sitting senator and representative in Congress to establish these colleges. Morrill could not have known the future impact this law would have in providing equal opportunity to education in the United States and its territories.

Today, there are more than 100 land-grant institutions in the United States and its territories, each focusing on teaching, research and outreach – taking new knowledge to the people.

Acknowledgements

We are grateful to the Robert and Ardis James Family Foundation for its vision, guidance and financial support. The James family founded Strategic Discussions for Nebraska in 2007 and their funding and support continue to make this program possible.

Beginning July 1, 2010, the University of Nebraska-Lincoln Institute of Agriculture and Natural Resources (IANR) began a financial and programmatic collaboration with Strategic Discussions for Nebraska. The program is deeply appreciative of the IANR collaboration and support.

In October 2011, Strategic Discussions for Nebraska moved to the UNL Institute of Agriculture and Natural Resources, College of Agricultural Sciences and Natural Resources, Department of Agricultural Leadership, Education and Communication.

We express appreciation for the advice of the Strategic Discussions for Nebraska Advisory Board members:

Mark Balschweid, Ph.D., Head of the UNL Department of Agricultural Leadership, Education and Communication

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Strategic Discussions for Nebraska

Strategic Discussions for Nebraska moved to the University of Nebraska-Lincoln Institute of Agriculture and Natural Resources in October, 2011.

The content of this publication is written by students enrolled in a UNL Magazine Writing course, taught by the SDN coordinator. The IANR Educational Media unit provided videography, video editing, graphic design, photography, website, business and liaison services for the production of this publication, as well as for its website: www.unl.edu/sdn/opportunities.

Special appreciation

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Message from Harvey Perlman
Chancellor, University of Nebraska-Lincoln


Harvey Perlman

There is no doubt that among the most pressing issues that will face our world in the next half century is how we will feed our growing populations. By 2050, our planet will need to support 9 billion people. And course, our planet is not growing any more arable land or producing more usable water. It is comforting to know that the best minds are already thinking ahead, planning for and laying the foundations for strategies to feed the world. And many of these minds are right here at the University of Nebraska-Lincoln. Similarly, the economy of Nebraska is well positioned to take a leadership role in both development and application of the new technologies necessary for addressing food scarcity.

This edition of Strategic Discussions for Nebraska, a project of the University of Nebraska's Institute of Agriculture and Natural Resources, examines this problem. Opportunities for Nebraska, Volume Three: Food Scarcity engages the very best scientists, thinkers and researchers at the University. Researched and written entirely by students in a special topics Magazine Writing class, Food Scarcity was supported by the University of Nebraska Institute of Agriculture and Natural Resources, which under the leadership of Ronnie Green, its Harlan Vice Chancellor and University of Nebraska Vice President, is a key partner and collaborator in the project.

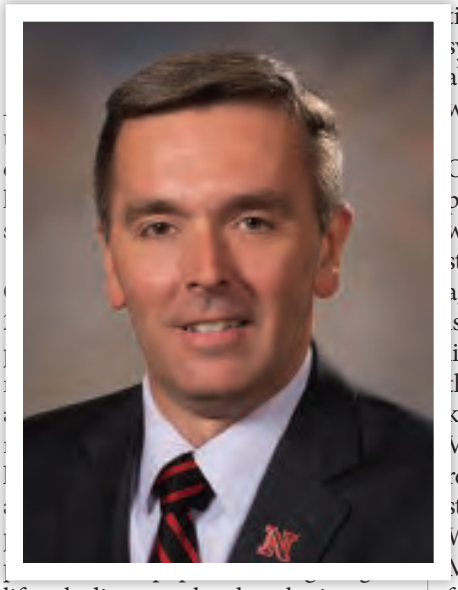
I am proud that Nebraska is, and will continue to be, a leader in the efforts to feed the world. Whether it involves developing new crops, new production methods, new technologies, or new influencing policies regarding land and water use, health resources and food distribution, UNL faculty are involved at every level. Eyes are on Nebraska to help address food scarcity. That will indeed be the overwhelming challenge for the generation of students who are now enrolled at UNL. The students who have taken part in researching this publication will have a better knowledge of the problem, and we envision them becoming informed decision-makers. Strategic Discussions for Nebraska allows our citizens to become involved as well. This publication bridges the gap between the laboratory and living room – giving Nebraskans the facts and materials necessary to make critical decisions about issues that will affect the future. We hope these publications spark discussion, comment and further inquiry.

We are indebted to the Robert and Ardis James Family Foundation whose generous contributions launched Strategic Discussions for Nebraska. Congratulations to Project Director Mary Garbacz of the College of Agricultural Sciences and Natural Resources and to the students who researched, wrote and created this publication. I thank the many faculty members across the University who served as sources for the project. Thanks also to the members of the Strategic Discussions for Nebraska Advisory Board, who come from the University and the wider Nebraska business and educational communities. This group's aid in identifying and targeting topics of interest has proven invaluable. And I extend particular thanks to Ronnie Green, vice chancellor at IANR, for his interest and ongoing support.

I know you will find this publication to be a useful tool in formulating opinions and policy that advance Nebraska's progress.

Message from Ronnie Green

Vice President, Agriculture and Natural Resources, University of Nebraska and Harlan Vice Chancellor, UNL Institute of Agriculture and Natural Resources



Ronnie Green

lifestyle diseases related to obesity.

IANR's innovation in research, teaching and extension education can play a key role in helping to adequately feed our growing population. Our focus is on how to produce more food with less energy, less land and less water. Bringing more food into the market is vital. Enhancing production and efficiency of production, while maintaining a greater degree of environmental sustainability, is central to our success.

Food, natural resource and energy security are the greatest challenges of our time. But it is a challenge worth fighting, especially when we live in the breadbasket of the world. In Nebraska we are blessed with resources to produce food. We have more than 45 million acres of farmland. Nebraska leads the country in the production of red meat, Great Northern beans and popcorn. We come in second in the production of pinto beans, proso millet, corn for grain production and dry edible beans. One in three jobs in Nebraska is directly ied to agriculture and food production ystems. Every Nebraskan should care bout what we do and be proud of what we do.

Our goal in IANR is to remain the premier land-grant university in the world in the agricultural life sciences study of natural resource systems, and agricultural and food policy. A goal that s achievable, thanks to publications ike Strategic Discussions for Nebraska hat allow us to think critically about key issues. Opportunities for Nebraska, Volume Three: Food Scarcity is researched and written entirely by students in a special topics Magazine Writing class, under the direction of Mary Garbacz. Strategic Discussions for Nebraska is supported by IANR, as we hope these publications spark discussion and allow you to become involved in this important conversation.

Our heartfelt thanks go out to the Robert and Ardis James Family Foundation whose generous contributions launched Strategic Discussions for Nebraska. Donors such as the James family help shape the future of our state through their philanthropic spirit and passion for education. I would also like to thank the many faculty members across the University who served as sources for the project. Telling our story is everyone's responsibility and I appreciate faculty taking time to share their experiences and insights.

Thanks also to the members of the Strategic Discussions for Nebraska Advisory Board. Made up of people within the University and the wider Nebraska business and educational communities, this group has been vital in brainstorming topics of interest.

I hope you enjoy Opportunities for Nebraska, Volume Three: Food Scarcity. I look forward to looking back on it in years to come and reflecting on the progress we have made in growing a healthy future for our state, nation and world.

Message from Steven Waller

Dean of the UNL College of Agricultural Sciences and Natural Resources

Food scarcity – the challenges are clear. The solutions are even clearer.

The solutions are rooted at the interface of science and education that occurs at our public land-grant universities. The land-grant institutions have met the challenge of helping feed the world in the past and will play a bigger role in the future. This global problem – food scarcity – will be solved by global leaders and by innovations in production agriculture. Nebraska and its public land-grant university have a global reach and impact, particularly in food, fuel, water, landscapes and people.

Global food scarcity is not just about food production, it's about education. It's also about the socio-economic factors that make food accessible and affordable to everyone; it's about health, poverty, and political stability – all serving to reinforce the complexities of the solutions and the importance of a university education at a Research One institution like the University of Nebraska.

Approximately one-third of the world's population has had no formal classroom experience. Two-thirds of the world's population has less than a sixth-grade education. Only 6.7% of the world's population holds a bachelor's degree (Harvard and the Asian Development Bank, 2010). And yet, we must double food production on a global basis to meet the population growth projected for 2050. That increased food production must occur without any new base resources, land or water – 70 percent of that increase in food production must come from innovations and technology efficiencies created through science.

Education is the key; it drives our science.

Nebraska's citizens can be very proud of their investment in the University of Nebraska land-grant system and particularly the University of Nebraska-Lincoln (UNL) undergraduate education programs administered through the College of Agricultural Sciences and Natural Resources (CASNR). Seventy-three schools competed nationally for recognition as innovators in undergraduate education. Only 16 were selected. UNL is one of the 16 – the only land-grant institution. In fact, UNL is one of only five major research universities to be named 'first tier' for our innovative programs for undergraduate students. The other universities are:

- Duke University
- University of Michigan (non-land grant)
- University of Southern California
- State University of New York at Stony Brook

Our UNL Institute of Agriculture and Natural Resources (IANR) scientists are among the most-cited agricultural scientists in the world.

Science Watch evaluated universities and research organizations based on the Essential Science Indicators (frequency research articles are cited by other authors) from 1998-2008. IANR ranked 17th in the world among all research organizations, 9th among American universities and 3rd in the Big Ten (Wisconsin, Penn State and UNL).

The state's investment in Nebraska Innovation Campus and the promise that it holds to address life science issues will ensure UNL's continued leadership in agricultural and natural resources research.

The power of a Research One institution that cares for and invests in its undergraduate education and fully integrates its research into the classroom is a synchronous education. UNL provides an education informed by its research. UNL engages its undergraduate students in the research and scholarship that will become the answers for tomorrow's challenges. The scientists discovering the new knowledge are the same faculty members who teach, advise and mentor our undergraduate students, engage students in undergraduate research, advise student organizations and lead study-abroad tours.

New discovery and knowledge are always happening at UNL. And no graduates will be better prepared to embrace the challenges of food scarcity and other global problems than those graduating from CASNR.

The people that will solve the problems of food scarcity in 2050 are in colleges and high schools today. There is no reason why the next Norman Borlaug or Henry Beachell can't be sitting in a classroom in a Nebraska high school or at UNL today; in fact there is every reason to expect that.

There truly is "No Place Like Nebraska"!

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A Place Without Limits: NU's Leading Role in Ag Innovation

By Renee Pflughaupt

James B. Milliken

The University of Nebraska, as a leader in agricultural research and innovation, has the support, the talent and the resources to help ease food scarcity concerns worldwide.

Those are the words of James B. Milliken, president of the University of Nebraska. Milliken said that "the world faces a significant challenge" concerning food scarcity issues related to population growth that is expected to increase from the current seven billion to nine billion by 2050.

"If we have a challenge at seven billion, we're clearly going to have a challenge at nine billion," he said. And the world, he added, has only a finite amount of land and water resources.

"The solution," Milliken said, "has to be innovation and science. And that's what universities like the University of Nebraska do."

A land-grant university

Nebraska, Milliken said, has a history of being engaged in agricultural research and extension. For years the university has been working with local farmers, institutions, other universities and governments in addressing food production issues.

The University of Nebraska was established in 1869 as part of the Morrill Act of 1862. This act granted federally-controlled land to individual states to establish land-grant universities. The focus of these schools would be to teach agriculture, science and engineering.

The University of Nebraska's mission as a land-grant university expands far beyond this. Milliken said places like NU are "places where not only is there research done, but there is a model of transmitting that research into the field."

Agricultural research has been critically important, Milliken said, for the state of Nebraska. And for that reason, the university is increasing its investment in its agriculture, research and education programs.

"We think it's critically important," Milliken said. "It's important for Nebraska as long as any of us will be around."

Investing in the future

The university has taken on a number of initiatives to expand its work in agricultural research, including Nebraska Innovation Campus and the Robert B. Daugherty Water for Food Institute.

Nebraska Innovation Campus, to be built on land granted by the state of Nebraska to UNL in 2009, will "link the capabilities of the private sector with the university," Milliken said.

The Daugherty Water for Food Institute will bring the university to "a key place in the world, in this discussion about how you more effectively use water for increased productivity in agriculture," Milliken said.

Such investments, he said, will only increase the mark the university makes in the world. And as the prestige of the university grows, it "becomes a place that's a magnet for the best talent."

"It's enormously beneficial to the state of Nebraska," he added. "We [Nebraskans] will benefit from the research that's done here. Our students will benefit from the talent that's here and the education that they get. And the state of Nebraska will benefit."

Reaching beyond borders

The university, while benefiting the state of Nebraska, is also looking to institutions and countries worldwide to share its agricultural research.

"The world," Milliken said, "faces a significant challenge…We are going to have to help people understand, here and elsewhere, how to be more productive."

The university accomplishes this in part through extension programs. Extension faculty extend their research findings to various extension centers throughout the State of Nebraska. But the university's work doesn't stop at the state's border.

Milliken said the university has a rich history of using science to change the world, such as during the Green Revolution in the 1960s and 1970s –a series of agricultural research initiatives focused on increasing food production worldwide.

Thanks to the Green Revolution, tens of millions of people survived, he said, who wouldn't have otherwise without the research and development of wheat strains that increased food productivity in those areas.

And that legacy continues today. More recently, Milliken said, software written by NU faculty was used in China to increase corn production. As a result of this technology, the corn yield doubled with half the fertilizer and half the water.

"The research at the University of Nebraska," Milliken said, "has no limits. And there's no reason that we can't be an effective partner with people anywhere in the world."

"Ag is Sexy Again" as Global Need for Food Increases

By Brooke Talbott

"I really believe that we're sitting at the front end of a complete renaissance for agriculture in the world… what some are calling the 'golden age for agriculture,'" said Ronnie Green, University of Nebraska Vice President and Harlan Vice Chancellor of the Institute of Agriculture and Natural Resources (IANR).

Demographers predict that by the year 2050, the world population will grow from the current seven billion to more than nine billion; meaning food production must double to meet demands. Nebraska is going to be a great contributor to producing the food for the world, Green said.

"Ag is sexy again," he added.

The current generation displays a greater interest in agriculture than in previous generations, Green said. There is something about agriculture that is wholesome and appeals to them, he said, which was not the case 20 years ago. This is evident in the emergence of online farming games that are, according to Green, "all the rave amongst urban dwellers."

Addressing global food scarcity issues is one of the biggest challenges the next generation will face, Green said. Anyone can be a part of addressing it; anyone can be a part of figuring out how to effectively use resources long-term to feed the world.

Society needs to understand the importance of the food system and its long-term maintenance, Green said. One of the base requirements of the stewardship of the natural resources is to produce what is needed for the health and well-being of the world population.

"Every Nebraskan should feel that is important and that it is a responsibility we all have," Green said. "That doesn't matter whether you're a lawyer in downtown Omaha or whether you're a farmer in Chase County, Nebraska."

Global mismatch of resources, people

Globally, there is a mismatch of land, people and resources, Green said. There are areas that do not have enough food, areas that do have enough food and areas that have more than enough food.

Of the seven billion people in the world, one billion are considered malnourished. At the same time, one billion are considered to be overweight. Of the billion people overweight, more than 300 million are considered to be obese. As a result, the latter group faces lifestyle diseases as a result of too much food or the misuse of food, Green said.

Countries that are food-scarce cannot sustain their own populations because they don't have sufficient natural or human resources, he said. Other countries that are food-secure, such as the United States, can sustain their own populations and often can produce surplus food for export. Inadequate access to food, distribution of that food and issues related to the transportation of food are additional factors that play into this, Green said.

"Fast-forward 40 years from now, with two-and-a-half billion more people," Green said, and there will be "more mismatch of where people are going to be relative to the resources to produce food."

If the world's cropland were put together, it would be nearly equivalent to the surface area of South America. If the world's pasture land were put together, it would be nearly equivalent to the surface area of Africa. The challenge is to find ways that crop and pasture land can produce to their potential without depleting natural resources.

Faculty and staff within the UNL Institute of Agriculture and Natural Resources are focused on producing more food with fewer natural resources. Increasing efficiency, productivity and sustainability of the resource base is the mission of IANR, Green said, with a focus on finding ways to produce more food and fuel with less water, land resources and capital required per unit of production.

Enhancing human health with adequate nutrition is part of that equation, too, Green said.

The expertise in Nebraska on agriculture and natural resources will contribute to solving the global food challenge. "Nebraska is really the epicenter of food production," Green said. "As a state, we need to pay careful attention to the maintenance of the resources that we have, have the right kind of system in place that conserves those resources in the right way and uses them wisely."

Nebraska's economy is heavily-reliant on food production; one out of three jobs in Nebraska is related to agriculture. Nebraska ranks first in the United States in commercial red meat production, first in Great Northern bean production and first in popcorn production, based on 2010 national estimates. The top four crops grown in Nebraska are corn, soybeans, dry edible beans and wheat for food and livestock feed, said Green.

"We live in the breadbasket of North America, which is one of the greatest breadbaskets of the world," said Green. Because of this, Nebraska – and the way Nebraskans think about how to better use the world's resources long-term – is critical to feeding the world.

"Every Nebraskan, whether or not they're engaged in agriculture and the food system directly, should understand and care about the issues about feeding the world," Green said. "Agriculture and the food production systems are of importance to Nebraskans because agriculture is the core of who we are."

Ronnie Green

Focus on opportunity: NU Rural Futures Institute

In the last 50 years, there has been a shift in population from rural regions to larger urban areas. That is why the University of Nebraska is forming the Rural Futures Institute, set to launch in late September 2012. This institute will focus not only on Nebraska, but on the entire Great Plains region.

The mission of the IANR is to efficiently increase production, as well as sustainability of the resource base. "By definition, when you do that, you create a system that requires fewer people to produce the same amount," Green said. "Or in the future, fewer people to produce more."

Green said there is an obligation to look at the future of the rural landscape, including how the communities will look 50-75 years from now.

"If you look at Nebraska, for example, we have 93 counties," Green said, and "all but 16 of those counties have lost population, decade after decade." Part of the reason is because the agricultural and food production systems have moved to a larger-scale system and have become more efficient.

The Rural Futures Institute will address health care, nutrition, finance, new business development and infrastructure, the landscapes and the food systems of rural communities – by drawing on expertise from all campuses of the University of Nebraska.

"We live in a very different world today than we did 10 years ago," said Green. "Today there are opportunities for rural regions that we never thought there might be, because the world operates differently than it did before."

The way we do business, commerce, communication and the way we learn have changed, he said. One does not have to be in downtown Omaha to be in major commerce or be in the center of New York City to be in the center of the universe. Technology enables businesses to operate out of rural regions.

"If you fast-forward to 10 years from now or 20 years from now, based on what we've seen change in the last 10 years, you can start to envision opportunities in rural landscapes that haven't been traditionally thought of as possible," Green said. There are rural commerce opportunities, tourism and eco-tourism opportunities.

One of the things the Great Plains region has begun to understand about itself, Green said, is that the area has a really unique set of natural resource ecosystems. People are very interested in the Sandhill crane migration and in the fossil beds in Western Nebraska, he said. Opportunities surround those attractions.

"One of the biggest challenges that rural regions are going to have, I think, is this transition from the past to the future," Green said.

Land-grant mission observes 150 years

"The Land Grant Act has created a system that's been the envy of the world," Green said.

The year 2012 is the 150th anniversary of the Morrill Land Grant Act of 1862, proposed by Justin Smith Morrill and signed by President Abraham Lincoln in the midst of the Civil War. "President Lincoln really saw that as critical to food security in the United States at a time point in the Civil War when it was a challenge for us," Green said.

The University of Nebraska is Nebraska's land grant university. "We're the people's university," Green said. The Morrill Act of 1862 granted 30,000 acres of land to each state and territory for each senator and representative in Congress. The land was allocated to establish at least one college in each state where the leading object would be to provide instruction in agriculture and related areas. The Morrill Act also made higher education available to "the industrial classes," instead of only the wealthy.

The Second Morrill Act was enacted in 1890 and established financial support of the land-grant institutions. This act not only established significant funding for instruction in food and agricultural sciences, but also funds for educating instructors in these areas. The Second Morrill Act also stated that no funds would be paid out to a college in any state or territory in which a distinction of race or color was made in the admission of students.

In 1914, the Smith-Lever Act was signed, creating the Cooperative Extension Service, a partnership between land-grant institutions and the United States Department of Agriculture. The mission of land grant institutions evolved to teaching, research and outreach.

"My feeling is that the land-grant mission of teaching, research and outreach for the public has never been more important than it is today," Green said. As Nebraskans move into facing future challenges of food scarcity, the land-grant mission – educating the next generation of leaders – will be critical to feeding the world.

"I think the next 50 years are going to be as critically important – or more so – than our past has been."

Today's Students – Learning to Solve the Challenge of Feeding the World

By Brooke Talbott

Steven Waller

Effectively addressing the world's growing need for food will hinge not only on the scientific research advances in agricultural sciences, but also on the mindsets of students sitting in classrooms today.

"Food scarcity touches every person on the planet," said Steve Waller, dean of the College of Agricultural Sciences and Natural Resources (CASNR) at the University of Nebraska-Lincoln. "I think the most powerful thing is to envision yourself as part of a global community," he said. "We all eat."

Food scarcity is part of every student's future, Waller said. The people who will solve the production challenge are in our colleges today, he said. They will be either mid-career or at the peak of their careers when the world population reaches nine billion.

"It's part of the future their children and their grandchildren will live in," Waller said, "and consequently, to ignore the food issues that are global in nature would be a mistake."

Increasing agricultural literacy

Educators today need to focus on "broadening the umbrella of agricultural literacy" by connecting students with the production systems that grow the food they eat, Waller said. Students need to understand the food production system, the importance of nutrition, stewardship of resources, interpersonal development and how to get involved in their communities. "We can be educators locally and developers, entrepreneurs and researchers internationally," he added.

By educating local students, the knowledge they gain will spread to people around the world as students "touch other lives" with their expertise, Waller said. "One of our great challenges is going to be to educate our own public in the United States," he said. "I think it's a land-grant responsibility nationally to make sure that the public understands their food and fiber systems because much of the food production is going to come through the United States."

The University of Nebraska-Lincoln is one of more than 100 land-grant institutions in the United States and its territories. The Morrill Act of 1862 established the land-grant system and provided 30,000 acres of land to each sitting congressman to establish land grant universities. The Second Morrill Act of 1890 established funding for those institutions. Prior to the Morrill Acts, education was accessible only to the upper class; the land-grant universities made higher education accessible to all people.

As a land grant institution, Waller said, the faculty, staff and researchers in CASNR are connected to Cooperative Extension, which develops programs that translate scientific research into practical applications.

Cooperative Extension was established in 1914 by the Smith-Lever Act, which formed a partnership between land-grant universities and the United States Department of Agriculture. Cooperative Extension programs extend nationally and internationally to promote lifelong learning for people of all ages, said Waller.

Faculty members from CASNR are teaching kindergarten through 12th graders about agriculture, stewardship of resources and the STEM areas of education: Science, Technology, Engineering and Mathematics. Through these programs, students learn to connect the food on their plates with the process of agricultural production. Waller said today's youth will address the issue of food scarcity in the years to come, which is why learning at an early age is important.

Children can't be exposed to science too soon, Waller said, as long as it is done with age-appropriate learning. "Having young children appreciate what their world will be like and how they can help is important," he said. Kindergarten students going through extension programming in Lincoln, Nebraska are learning concepts like photosynthesis and can adequately relay the information to one another, he said.

"I think one of the things we often do is underestimate what those young children can grasp and understand, and that they actually will change the world."

Global campus, global learning

"I think there's no place like Nebraska," said Waller. "But if we embrace the responsibility of being one of the leading land-grants in agriculture, then I think our students also must accept the responsibility of contributing to the solutions globally." Students need to have a concept of what it means to be a global

citizen, Waller said, "from food all the way through other aspects of their life."

Waller believes students better understand the magnitude of an issue when they are exposed to it. "I think that's part of what a university education is all about…to really get a glimpse of things that they don't know firsthand," he said.

Students need to have some exposure beyond their own cultures, Waller said. When educators ask students to solve a global challenge, those students need to have the confidence that they can function in a global environment, he said. Learning about different environments, cultures and sometimes languages can provide the understanding and confidence to help solve those challenges.

Study-abroad programs are great ways for students to gain that confidence and capability, he said. CASNR offers study abroad programs at international institutes in Brazil, China, India and South Africa, among others.

"My goal would be that our students get out and about, share their knowledge, help solve problems, but ultimately find a way back to enjoy the good life," Waller said.

Opportunities in Nebraska

As for local opportunities for students to grow, CASNR offers courses that focus on interpersonal development through community service, Waller said. Those courses help students learn how to serve, how to manage their time, how to value serving within their community and how to lead on a local level.

"We expect that all of our students give back, be engaged and realize how fortunate they are," he said. Nebraska has vast amounts of land, water and human resources that will pave the way for students to be leaders in educating people around the nation and the world about agriculture and production systems. "That's their way of giving back and that's another way to solve some of these future challenges," he said.

Nebraska Innovation Campus will bring the public and private sectors together to address food and water issues that are global in nature. The opportunity to be at the center of a campus that addresses issues that are global in nature is incredibly important, Waller said. "It's going to permeate the whole culture of this university."

Nebraska Innovation Campus is a public-private technology development at the University of Nebraska-Lincoln on the former site of the Nebraska State Fair. The development will focus on technology innovations in food, fuel and water that will help to feed a growing world population.

"The private sector that comes into Lincoln will be looking at students as potential employees," Waller said. He envisions embedded scholarship programs that will benefit students and the private sector companies as together, they address the great challenge of feeding the future.

Addressing this issue will take people from all backgrounds, Waller said. "Everybody will play a part in the food scarcity issue…everybody can contribute to the challenges of the future if they treat each other with respect and appreciate differences," he said. "Because food scarcity is going to be the one that touches home first."

There is no single solution to this challenge, Waller said. There are challenges of distribution, transportation, politics, culture and socioeconomic barriers. "Doubling the crop yield and those kinds of things will be a science-based program, but that by itself won't solve the problem," he said. "We've got to have a broader approach and that will be the social sciences as well."

At the end of the day, said Waller, "I think if we prepare our students to be critical thinkers, futurists and optimistic, we are actually preparing them for the future."

Ag Researchers' New Knowledge Benefits Nebraska, the World

By Derek Brandt

The University of Nebraska – Lincoln has a long-standing reputation for being one of the world's most respected sources of research and information, especially in the field of agriculture and natural resources. According to Ron Yoder, associate vice chancellor of the University of Nebraska-Lincoln Institute of Agriculture and Natural Resources, Nebraska is the 16th most-cited institution in the world in agricultural research.

But who uses this research, and why?

"There are several communities of users of our research," said Yoder. "One would certainly be the farmers and the ranchers of Nebraska and our region who use, and have used, for over 100 years, the results that come from research done here."

One of Nebraska's most respected research topics is in the area of tillage. Nebraska specializes in no-till or conservation tillage. Tillage is the preparation of soil and the land for growth of crops. It is a subject that UNL has researched extensively in its history and, according to Yoder, is recognized as one of the world's leaders in the subject.

Nebraska is known for its research crop water use, management of irrigation, wheat breeding, meat science and the relationship of allergens to food.

"What is being done in the Food Science and Technology department in that area is being recognized as possibly the very best in the world in that area," Yoder said.

UNL's results come from years of research. That research is used by other research institutions to incorporate their own ideas and create unique hypotheses. Other institutions use the information found in the UNL studies and use it to build their own research programs.

Commitment to Nebraskans

But most of all, UNL has a commitment to the people of Nebraska. One of UNL's main goals is to make sure that Nebraskans can benefit from its research.

"As a public land-grant university, we feel like we have a significant commitment to meeting the needs of the people of Nebraska," Yoder said. "That is a key part of what we do. That is to engage those people who can benefit from the work we are doing, and also to get feedback on what kind of research and what kind of outreach we should be doing."

Ron Yoder

A good example of the type of research that is being done at the University of Nebraska is in irrigation. Yoder has been closely associated with management and use of water for irrigation research. Researchers work with farmers to calibrate and adjust the amounts of water being used for irrigation of crops. Depending upon the amount of water used, it has been shown that on a broad range of farms, up to two inches of water per year can be saved.

"Just to put that into perspective," Yoder said. "If you take that two inches and you were to extrapolate that across all of the irrigated acres that we have in Nebraska, that would be enough water to fill Lake McConaughy to 80 percent for one year. That is how much water we would save in one year." Lake McConaughy is a 56-square-mile reservoir in west-central Nebraska.

Water is a finite resource and its conservation is a university priority.

"Industry uses it for cooling and processing," Yoder said. "Agriculture uses a lot of it and of course, when water is used for agriculture, it is really using it directly for people because people eat the food that is produced by the agriculture."

Yoder said people need to recognize those that came before them, the plants and animals and the entire ecosystem. These are all competing for the use of water and balance must be maintained to keep a healthy environment. UNL is researching the most eco-friendly ways to use water.

"So, there is a lot of debate," Yoder said. "And one of the key contributions of the University of Nebraska is to provide science-based information for making difficult decisions on natural resources and how to allocate the different parts of the water system."

Extension: spreading the word about UNL research

The University of Nebraska, through extension, passes along research to those who need it. Yoder believes UNL does a good job of passing along the research results and information.

"As a land-grant university, we have an excellent extension division," Yoder said. "The extension division has individuals that are located in most of the counties in Nebraska, as well as here on campus, and work very closely with the people of the state to get the information to them."

According to Yoder, the way that the research information is being passed along is evolving rapidly. Along with the extension division representatives, it has become much easier to share information over the past two decades with the advent of the Internet and social media. It hasn't always been easy or fast to spread information across the state, though.

"There used to be trains that would go across Nebraska and the train would be loaded up with extension people," Yoder said. "They would stop in every town they came to and they would give an extension program and demonstration. Today, that has progressed all the way to where social media has become a way to spread information and provide information. Between those two extremes, almost any way you can communicate to people has been used."

Research – methods and history

"Most good research is hypothesis-driven," Yoder said. "In other words, you look at what has been done, you look at what is not known, you look at what you think would solve a problem or address an issue. If you know an answer and then you come forth with a hypothesis of what might be and you do the research, you design the research to answer that question and to prove or disprove the hypothesis."

Researchers at UNL also measure natural phenomena and compare what happens. For example, according to Yoder, in crop water usage research, a researcher is measuring the amount of water that a crop uses and then applying varied conditions in which the crop is growing.

"You're making measurements of all the factors that go into determining how much water the crop is using," Yoder said. "And then from that, you can develop relationships and algorithms that can be used to predict how much water we use under other conditions."

These experiments, among others, are done on UNL's experimental farms.

"Today we have a series of facilities across the state that are set up to do high-tech, high-level agricultural research, Yoder said. "Many of those farms have sophisticated irrigation systems, sophisticated systems for managing animals and making measurements."

There are experimental farms in different areas of Nebraska, due to the greatly-varying growing conditions throughout Nebraska. These farms are located near Sidney, North Platte, Concord, Mead and Scottsbluff, as well as in the Nebraska Sand Hills.

Some of these experimental farms have been in operation since UNL began its initial research in the late 1800s. Nebraska has been conducting agricultural research since the university was founded in 1869.

"Our first experimental farm was set up in 1871," Yoder said. "The Nebraska Agricultural Experiment Station began in 1887 and then in 1974, the Institute of Agriculture and Natural Resources was founded and throughout that entire history, the university has been involved in doing that sort of research that increased agricultural production in Nebraska as well as conserve the natural resources, and soil and water resources of Nebraska."

Research that expands personal understanding of a subject can be the most gratifying, according to Yoder.

"I think most research is actually incremental. There are very few researchers that have the privilege of making the really big discovery and the really giant step," Yoder said. "For many of us, it has been a matter of small steps where we ourselves have begun to understand things which have led us to think about a particular problem or particular issue differently – and then to approach that in a slightly different manner. Those things all build together, along with other colleagues, to paint the whole picture."

"Failure is Not an Option" in Addressing Global Food Scarcity

By Emma Likens

Archie Clutter

The Agricultural Research Division oversees all of the research within the Institute of Agriculture and Natural Resources and the human science units of the College of Education and Human Sciences at the University of Nebraska, according to Archie Clutter, Dean of the Agricultural Research Division at the University of Nebraska-Lincoln. The areas of research are focused on food, fuel, water and people, and range from cropping, grazing and ecosystems to human nutrition and early childhood development.

Tremendous challenges, tremendous opportunities

Clutter said there are tremendous challenges facing agricultural producers to feed a population that is expected to reach 9 billion by 2050. He said these challenges are not far off and will hit during the lifetime of today's young people.

"Failure is not an option. It puts pressure on food availability, it puts pressure on food cost. Those things can cause instability around the world," Clutter said. Food scarcity issues can put downward pressure on economic systems locally and globally, and inhibit quality of life.

While there are tremendous challenges, Clutter also believes there are tremendous opportunities within the university and Nebraska to take a global leadership position in facing those challenges, thanks to university programs and Nebraska's natural resources. Clutter said the variety of growing conditions within the state create a living laboratory and allow for research that will impact Nebraska and other parts of the world.

Clutter also looks to advances in technology and research methods and drawing young, bright minds into agricultural sciences. "People are what fuel this process," Clutter said, "The only way we're going to be creative enough and powerful enough in our research is if we have the people that can take it up a notch." He said important research is more than innovation or creativity; it also is about operating research programs in more strategic and efficient ways.

Global food challenges

Clutter said food scarcity can take many forms, and so can the research in the Agricultural Research Division to address scarcity issues. He said degrees of food scarcity can range from people who don't have the nutrients they need to be healthy to real starvation, usually because "there's not the right combination of local food production and distribution of food."

He also attributes the causes of food scarcity to political situations or the cost of food relative to the means of the people. If the cost of food becomes too great, it can cause instability. Clutter hopes that as the global population grows, so will prosperity. He cites examples of expected population and prosperity growth in India, China and Brazil, which will bring new demands on food supply. "The nine billion people that we expect to be on the planet by 2050 or before may consume more like 12 billion people based on today's food per-capita consumption rates," he said.

More food consumption will bring more pressures on food supply. "They're going to be significant players in not only the global food demand, but also the economic engine that will need to fund research in agricultural sciences," Clutter said, including research that will be done at the University of Nebraska.

Genetic potential becoming more practical

Clutter looks to genetic potential as a starting point to provide food for the world. Over the past several years, he said, crop yield improvements have been leveling out, which creates a yield gap. Traditionally, genetic gains in plants and animals were made by selecting favorable characteristics in a species, then breeding the next generation. Clutter said the use of genomic information, or DNA, has been used in the past decade to determine characteristics and the potential

for transmitting favorable traits in plants and animals. He said the cost of genotyping, or sequencing the DNA of a species, has been drastically reduced and will make it a more practical technology to accelerate rates of improvement in genetic capacity.

Return on investment

The Agricultural Research Division receives base funding from the state of Nebraska; from USDA formula funding determined by factors such as population; and from grant dollars originating from federal agencies and private sector partners. A recent independent study estimated that the programs of the Agricultural Research Division have averaged a 36 percent return on investment for over 30 years. Clutter said there are many great examples of this funding at work for the betterment of Nebraska and the world, and offers one of those examples within the division that demonstrates the impact the investment can have on global food supply. UNL wheat breeder Stephen Baenziger estimates that increased genetic capacity created through his wheat breeding program can account for more than $70 million of annual revenue to Nebraska, which is about a 20 to 1 return on investment. Clutter said more importantly, Baenziger has concluded this impact results in feeding nearly 3 million additional people every day.

Clutter said yields of important crops increased annually at a rate of 1.1 to 1.4 percent during the Green Revolution, a period of great technological development between the 1940s and late 1970s during which global agricultural production increased dramatically. With genomic information, he hopes to see rates increase to 1.8 percent annually by pushing genetic capacity and narrowing yield gaps, which will make it possible to feed nine billion people in the coming decades.

Nebraska Innovation Campus Will Address Global Food Issues

By Jessica Sorensen

Dan Duncan

"You probably ask 100 people, you're going to get 100 different answers, but I think food scarcity is both a quantity and quality issue," according to Dan Duncan, executive director of Nebraska Innovation Campus at the University of Nebraska-Lincoln. "It's not just having the quantity of food needed but it's having the quality of food, the nutritious food, to provide a good diet for everyone."

Nebraska Innovation Campus is bringing talented people together from private industries and the University of Nebraska to generate innovation that impacts the world, Duncan said.

Duncan said there are almost 250 acres of land for Nebraska Innovation Campus and because some of that land is in the floodplain, 130 acres of it is buildable ground.

Duncan said he hopes the land will be fully developed by 2037 or sooner.

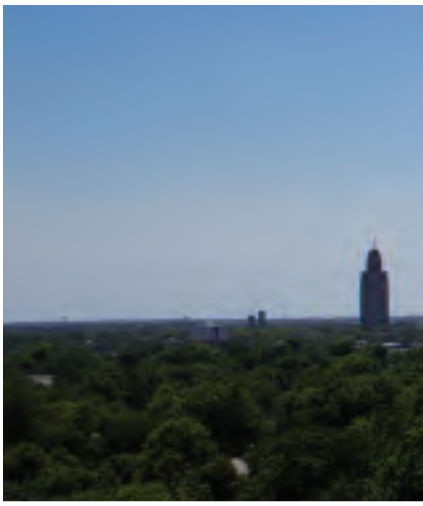
"It'll be a very dense urban-type environment like you would see downtown, with about two million square feet of class A office and research space," he said. "A little bit of retail space, maybe some housing, maybe a hotel and up to 7,000 people working in that environment in 25 years."

> "It's going to take multiple entities working together to solve some of the grand challenges."

According to Duncan, if Nebraska Innovation Campus were to reach its goal of building out 80,000-square-feet in a year, that could mean a cost of $25 million per year for construction and to populate and staff the buildings. However, this could result in significant activity for the Lincoln and Nebraska economy on an ongoing annual basis.

"We want to raise the stature of the university," Duncan said. "There's some very aggressive growth goals for the university in terms of a number of students, increases in faculty, increases in research expenditures and we'll be able to play a big role at Innovation Campus in enabling that to happen."

Building Nebraska Innovation Campus



According to Duncan, there will be a number of university entities that will be moving to Nebraska Innovation Campus when the first phase of building begins, with the most significant one being the Robert B. Daugherty Water for Food Institute (DWFI). Duncan said the first phase of building also will include business outreach and service operations so that NUtech Ventures, industry relations and Nebraska Innovation Campus offices can all be merged to one location.

Duncan said Phase One of the campus includes renovating two historic buildings and linking them with two new buildings. In this complex, there will be a greenhouse, labs, a 380-seat raised-floor conference room, an outdoor plaza and hopefully, a restaurant.

In addition, Duncan said researchers are working with faculty members to see what types of programs should be moved to Nebraska Innovation Campus.

"We picked themes for Innovation Campus based on where Nebraska's economy, strengths of the university and potential growth areas in research all intersected to develop broad themes that would give us a great starting point and increase our chances of success," he said. "Food, fuel and water, every one of those is critically important to every citizen in Nebraska. We think those themed areas together with the capability of our faculty provide a niche opportunity that others maybe aren't exploiting across the nation."

"Food, fuel and water, every one of those is critically important to every citizen in Nebraska. We think those themed areas together with the capability of our faculty provide a niche opportunity that others maybe aren't exploiting across the nation."

Duncan said he hopes Nebraska Innovation Campus will have a campus-type atmosphere.

"Innovation Campus plays a role in helping implement campus strategic plans," he said. "It gives us a place where we can do things that either aren't suited to do on campus or we aren't able to do on campus and so I would look at Innovation Campus more as supporting both the research and economic growth initiative."

Playing a part in the 2050 challenge

With the expansion of Nebraska Innovation Campus come new opportunities for research. According to Duncan, one area that Nebraska Innovation Campus is focusing on is the 2050 challenge.

"It's going to take multiple entities working together to solve some of the grand challenges," Duncan said. "Specifically, one we look at is doubling our food production by 2050 and how and what role we can play in solving that challenge."

According to Duncan, Nebraska Innovation Campus will promote collaborations between university and private industries and he expects there to be an environment of trust among researchers.

Lenton the Founding Director of Daugherty Water for Food Institute

By Brooke Talbott

Roberto Lenton

Civil engineer sets forth vision for "urgent" need for institute

As the world population increases, the challenge will be to resolve the competing domestic, industrial and agricultural demands on water, according to the founding director of the Robert B. Daugherty Water for Food Institute, Roberto Lenton.

The global situation is urgent because already there are rapidly-increasing demands on limited water resources. The available water is not sufficient to meet the multiple, competing demands, including agriculture, environment, industry and the water required by growing urban areas for drinking and for sanitation.

Agriculture accounts for 70 percent of water withdrawals globally and will be the first area addressed by researchers in the Daugherty Water for Food Institute, Lenton said.

At the same time, "thirsty cities" are expanding as people move away from rural areas and as a result, water resources are dwindling in many areas of the world, he said.

The goal of the University of Nebraska's Daugherty Water for Food Institute (DWFI) is to find ways to meet the growing demand for food without increasing the amount of water consumed.

The Daugherty Water for Food Institute was founded with a $50 million gift from the Robert B. Daugherty Foundation. Robert Daugherty founded Valley Manufacturing in 1946 in Valley, Nebraska, now known as the center pivot irrigation giant Valmont Industries.

Lenton said the DWFI is an institute specifically focused on improving water use in food production systems in Nebraska and around the world. The ambition, he said, is that the institute be the place people around the world will turn to for expertise on issues related to water and food.

"A big part of the challenge is how to ensure that agriculture, which is the largest consumer of water, is able to manage that water more effectively so that it gets 'more crop per drop,'" Lenton said. The challenge is to meet the growing demand for food without increasing the amount of water used to produce it.

Lenton is a civil engineer and holds a Ph.D. from the Massachusetts Institute of Technology. He brings to the DWFI his experience in India with the Ford Foundation; in Sri Lanka with the International Water Management Institute; with the United Nations Development Program, where he headed the environmental division; and with the World Bank's inspection panel. He joined the University of Nebraska in February 2012 as the founding director of the new institute. He decided to accept the offer to come to Nebraska because, he said, "the University of Nebraska had the imagination and vision to conceive of setting up an institute dealing with these issues of water and food." Nebraska has a tradition of giving significant importance to good management of agricultural water, whether it is rain-fed or irrigated from groundwater or surface water, he added. "And I also had a strong sense that the land-grant university system is really the best setting for research in water management issues."

"A big part of the challenge is how to ensure that agriculture, which is the largest consumer of water, is able to manage that water more effectively so that it gets 'more crop per drop.'"

"The vision is a very ambitious one," he said, and builds on the large body of experience that exists within the university and throughout the state. The vision for the DWFI covers both the natural and the social sciences, he said, including sociology, anthropology and political science. Sometimes political issues arise at very micro-levels, he added. The politics of water is a fact of life, he added.

"No single perspective is going to solve this problem," Lenton said, so it is important to form teams that represent a variety of perspectives. Along with researchers, the farming community and the agencies that develop water management policies also must be involved.

A collaborative effort

Lenton said he is pursuing water and food-related partnerships and collaborations across all the campuses and departments in the University of Nebraska system, focusing on how to make better use of water in food production systems.

"I like to see partnerships at least at three levels," Lenton said. The first level is within the university, with expert faculty and researchers. The second is within Nebraska – state government, natural resources districts (NRDs) and the farming community. The third is global, with research partnerships with countries like Brazil, China and India, who also are leaders in agricultural production.

The DWFI already has signed a memorandum of agreement with the United States Agency for International Development (USAID), Lenton said, and has a promising partnership with the UNESCO-IHE Institute for Water Education in the Netherlands. In June 2012, UNL and the University of Sao Paulo (USP) in Piricicaba, Brazil became partners in a new program that will allow research and exchange opportunities for faculty and students from both institutions.

Lenton said that he hoped to forge partnerships with institutes that deal with global issues of water and food, focusing on the poorest countries of the world where water management issues were the most critical in terms of poverty and hunger. He said it is important to recognize that some of the richer agricultural countries have a long tradition of good water management, but they too face many challenges in their efforts to balance competing demands for limited amounts of water. That is just one example of the individuality of the world's water challenges.

"You have to work very, very specifically in local context," he said. The problems and the challenges may be similar, but the solutions are context-specific.

"There may be a temptation to think that there can be global solutions – that you can have cookie-cutter solutions – in water management, that's simply not the case," Lenton said.

Spreading knowledge, saving water

In Nebraska, Lenton said, it's clear that the university's research has increased farmers' productivity and income. The Daugherty Water for Food Institute, he said, has the potential to take that implementation of research one notch further by spreading the knowledge and experience in Nebraska to the world. The NRD experience in Nebraska would be valuable in other countries, Lenton said.

"We've got such a huge starting point because of the large number of faculty, scientists and researchers – and the advantage of being a land-grant institution," Lenton said. He added that the land-grant university system is the best setting for research in water management issues because of the strong connection between research, practice and policy.

"I think if you're going to have a center of this sort, you have to have it located in a place where these issues are vital," Lenton said, "where they resonate with people, where you can have a strong interest among all citizens. And you certainly find it here."

Growing More Food with Less Water, Improving Global Water Condition

By Brooke Talbott

Daugherty Water for Food Institute's Andreini brings global expertise to Nebraska

Marc Andreini

Water is used every day: by households for drinking and cooking, by industry for manufacturing and cleaning, and by farmers for growing crops and sustaining livestock. As the year 2050 approaches – the year that demographers project the world population will reach 9 billion - so does the challenge of growing more food. To meet this increasing food demand, crop yields must double. To double crop yields, water productivity must improve dramatically. Growing more food with less water is one of the goals of the Robert B. Daugherty Water for Food Institute (DWFI) at the University of Nebraska. Improving water management and infrastructure around the world is another.

Marc Andreini, a civil engineer and hydrologist, is a senior research scientist with the Daugherty Water for Food Institute. He has worked in several African countries to strengthen the management and productivity of water. With the Daugherty Water for Food Institute, Andreini is helping Nebraska researchers to establish partnerships with their peers in other countries.

"The University of Nebraska and Nebraska as a state have a lot to be proud of," Andreini said. "Water is well-managed here. Productivity is very high and we can share what we know with the world."

A united effort

The Water for Food Institute will initially target the countries of Brazil, Russia, India, China and Africa for research partnerships. "There are undoubtedly technologies, ideas and things that are being developed elsewhere in the world that we can benefit from," Andreini said. "As we learn more, we produce more, our research becomes more well-known, we'll attract more money to the University of Nebraska," Andreini said. "Not only for global research, but for research targeted at Nebraska issues."

Equally as important, the Daugherty Water for food Institute is looking for collaborators in the state of Nebraska. "There's already a great deal of expertise that we can tap into, Andreini said. That expertise is available across the state and especially within the four university campuses in Lincoln, Kearney and Omaha.

"As we work together, we'll learn from one another," he said. "And the capacity we build as a community is extremely important. I'm looking forward to that and I hope other people will join us."

Conditions around the world

Although water is used daily for domestic and industrial purposes, Andreini said the bulk of the world's water is used for agriculture. In the United States, 70 percent of water withdrawals are for agriculture; in less-developed areas, the figure is 90 percent. Since the amount withdrawn for agriculture is so large, even a small improvement in agricultural water productivity would make a big difference, Andreini said. "By improving the productivity of water, we end up improving the water situation globally."

The challenge for many countries, Andreini said, is "economic water scarcity" meaning they lack the infrastructure necessary to withdraw water for agricultural production. Less-developed countries do not always have the resources and equipment for water infrastructure that more-developed countries have built.

"People in urban areas don't grow their own food and are reliant on agricultural production from either abroad or the rural areas of their own country. We have to be able to improve agricultural production to the level that surplus can be produced to feed the people in the cities."

Some areas, like the Sahelian Zone in Africa – often called the Sahel – are very dry and have little available water. Other areas, like the Congo River Basin in central Africa have more than enough water, but do not have the financial resources to develop better water infrastructure - the reservoirs that store water, pumping systems that bring water to farms and irrigation systems to apply water to crops.

In the United States, Andreini said, farming is more capital-intensive than it is in other parts of the world. Much of the world's agricultural production is subsistence farming, meaning that farmers produce little or no surplus. In combination with an increasing population, he added, people are moving away from the countryside to the big cities and becoming more affluent, placing pressure on farm production.

"People in urban areas don't grow their own food and are reliant on agricultural production from either abroad or the rural areas of their own country," Andreini said. "We have to be able to improve agricultural production to the level that surplus can be produced to feed the people in the cities."

Dickey Reflects on Years as Dean of Extension

By Brooke Talbott

Elbert Dickey

"Within extension administration, you do a lot of what I would say is 'seed planting,'" said Elbert Dickey, "and the really cool thing is when you see those seeds blossom."

Dickey retired June 30, 2012 after 11 years as dean and director of University of Nebraska-Lincoln Extension.

"Over the course of time," Dickey said, "I've planted some seeds and now they're blossoming and they're going to result in a great harvest."

Dickey was with the University of Nebraska-Lincoln for 34 years, starting in the Department of Biological Systems Engineering in 1978 with an academic research focus on conservation tillage. Dickey was promoted to professor in 1987. He served as assistant dean of extension from 1991 to 1998 and as associate dean of extension from 1998 to 1999.

Extension houses the 4-H program, which has experienced great success under the leadership of Dickey and of Beth Birnstihl, who retired June 30 as associate dean of extension and 4-H program administrator. Of the 12 states that make up the North-Central Region, Nebraska is the leader in age-eligible youth engaged in 4-H programs. One out of three young people in Nebraska are engaged in some form of 4-H, he said.

Nebraska also leads the region in curriculum development and in national awards and recognition, he said, adding that the state also is in the upper quadrant in terms of grant monies received.

Dickey reflected on two of "the best highs" of his career.

One was at an extension program in Kearney, Nebraska. Dickey was scheduled to speak to an audience and arrived late, then there were issues with the microphone. Dickey said when the microphone started working, "I said something like: 'I've got fifteen minutes to tell you everything I know.'" He said, "to this day, I don't quite understand the chemistry that made it happen," but from that comment, "I had the audience in the palm of my hand… That was one of the coolest teaching experiences I've ever had."

The other memorable moment was when Dickey got a call from the United States Department of Agriculture in 2007, inviting him to be the extension and education advisor. "I wasn't anticipating that call. I was totally unprepared and I had to just stand there in a daze," he said. After encouragement from his associate dean at the time, Dickey accepted the two-year assignment and switched from working full-time in Nebraska to an assignment in which he spent two weeks in Washington, D.C. and two weeks in Nebraska.

"For me," Dickey said, "extension is my farming." Since he was young, Dickey has had an interest in farming. "When I was growing up," he said, "I really wanted to farm." But Dickey and his brothers were urged by his parents to attend college instead, he said.

When Dickey was an extension specialist, he said it was "a real treat" to work with farmers and understand more about farming in Nebraska. "I like the connection to the farm community," he said. "For me, it's been a continual evolution of my appreciation of the food production systems and the people that work in it."

"It has really been an honor to work at Nebraska, both as a specialist and then in extension administration. We have a lot of really good faculty and staff," Dickey said.

When asked about his retirement plans, Dickey replied: "One of the things I've shared with a few people is: even though I'm from Illinois, my wife is from Illinois, our retirement home is going to be in Nebraska." He plans to visit all of the United States National Parks from coast to coast, including Denali National Park in Alaska and Acadia National Park in Maine. Dickey also would like to return to Ireland and Scotland, the countries of his heritage.

Extension program is mission critical for the future

If you looked at extension in 1950, the focus was mainly on agriculture, Dickey said. "We've changed and we've grown." Extension not only addresses crop, livestock and soil issues; it addresses issues of water, nutrition, and child, youth, and family as well as issues related to community. "We're talking about science, we're talking about citizenship, we're talking about well-being," Dickey said.

One of the newer areas extension is focusing on are the STEM science areas (Science, Technology, Engineering and Mathematics). Extension educators and specialists are bringing STEM education to young people through robotics lessons in 4-H after-school programs.

"The opportunities for educational programs with young people, in my opinion, is just really unfolding," he said. "I think it's important for us to reach out to all young people and give them the opportunities that we can provide through the land-

grant base of our research...the better care you can give to young people, the better opportunities they will have throughout the rest of their lives."

Extension embraces technology

Dickey said in today's world, with 24/7 access to the Internet, it is critical that extension educators and specialists use technology and involve the computer in some way. Developing educational programs is not "one size fits all," he said, it's about customizing the programs to best meet the audience's needs. "We need to be thinking about the technology that we have access to," Dickey said. "How can we best use that in an educational setting and how can the client get the most out of the information we have in an environment that's available to them on their timeframe."

To keep up with rapid technological changes, extension has developed educational iPad applications to better serve clients. In addition, most printed circulars and publications are offered electronically. Numerous past publications and circulars have been submitted to online databases as well, he said.

Despite the convenience technology offers to clients, "the in-person meeting is still pretty critical," Dickey said. It allows one to get a better understanding of what a community issue might be, he said. The advice he gives for adopting rapidly-changing technology is: "Be nimble, be flexible and try to keep in front of the curve."

Land-grant mission

At the heart of extension is the history of the land-grant universities: make higher education available to everyone. "The land-grant," Dickey said, "created these wonderful colleges and universities across the country to give every person an opportunity to have higher education."

Signed by Abraham Lincoln in the midst of the Civil War, the Morrill Act of 1862 established land-grant universities in the U.S. which were devoted to advancing agriculture and the technical sciences. The legislation made higher education available to every person instead of only to the wealthy.

However, a great deal of the research done by the land-grant universities was confined to the students within the university, Dickey said. In the late 1800s, outreach programs began to develop and impact rural Nebraska, he said. The Smith Lever Act was passed in 1914 to formally establish the Cooperative Extension Service, a partnership between land grant universities and the United States Department of Agriculture.

Because of the partnership created by the Smith Lever Act, extension programs in Nebraska and elsewhere are directly connected to a research base. Having a connection to a research base, Dickey said, puts the community in a better position to address issues like food scarcity. As Nebraskans think about helping feed 9 billion people by the year 2050, he said, the strong connection to research places the people in a community in a better place to enhance production in a way that protects the environment.

Dickey said developing educational programs is really a synergistic loop of partnerships between the scientific research experts at the university, the extension educators and specialists, and the people in the communities. "It's kind of like we have the cake," Dickey said, "but with partners' resources, we can put icing on the cake."

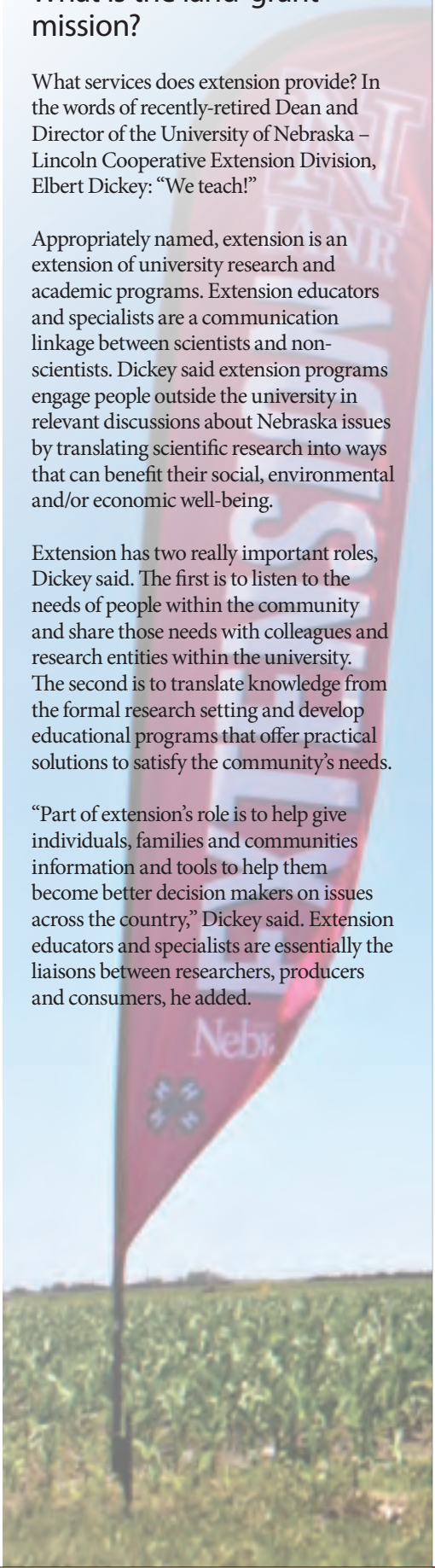
What is extension? What is the land-grant mission?

What services does extension provide? In the words of recently-retired Dean and Director of the University of Nebraska – Lincoln Cooperative Extension Division, Elbert Dickey: "We teach!"

Appropriately named, extension is an extension of university research and academic programs. Extension educators and specialists are a communication linkage between scientists and non-scientists. Dickey said extension programs engage people outside the university in relevant discussions about Nebraska issues by translating scientific research into ways that can benefit their social, environmental and/or economic well-being.

Extension has two really important roles, Dickey said. The first is to listen to the needs of people within the community and share those needs with colleagues and research entities within the university. The second is to translate knowledge from the formal research setting and develop educational programs that offer practical solutions to satisfy the community's needs.

"Part of extension's role is to help give individuals, families and communities information and tools to help them become better decision makers on issues across the country," Dickey said. Extension educators and specialists are essentially the liaisons between researchers, producers and consumers, he added.



Food Scarcity Information Dissemination Complex, Vital

By Emma Likens

Karen Cannon

On any given day, consumers are exposed to thousands of media messages. These messages are filtered by importance, according to needs, desires and interests. According to UNL Assistant Professor of Life Sciences Communication Karen Cannon, the challenge in disseminating information about food scarcity issues is getting past consumers' mental filters and onto their "radar screens."

Cannon said food scarcity issues are important on both local and global levels, particularly in the community in which an individual lives. If not enough food is available, individuals cannot be properly nourished. Cannon said this is especially problematic for school-age children. She said if students come to school with a lack of food and nutrition, "those students aren't able to learn as well and they don't get the full benefit of being the member of a community that will educate them and help them learn and grow." Cannon believes children need to have access to food and nutrition so they grow up to become contributing members of the community.

From a global perspective, Cannon believes food scarcity issues are not well-understood by the majority of people in the United States, and is complicated because the issues can look very different from country to country. Because of that, Cannon said it's important when disseminating information about food scarcity issues to remember that perspectives differ from one country to the next.

Learning to reach target audiences

Teaching students how to disseminate information to different audiences is Cannon's main purpose. Audience identification is vital, because different audiences have diverse interests and preferences. Cannon said messages have to be "sticky," or attention-grabbing for the targeted audience. Messages must cater to the audience's wants and needs and break through mental filters with information about food scarcity issues.

After the message has been created, it must be in the proper media avenue to reach the targeted audience. While digital media and social media are huge players in today's media, she said different generations have different preferences, and it's important not to forget those who prefer more traditional media. Different audiences use social media differently, and should be considered when disseminating information.

Globally, Cannon said evidence of the role of digital and social media lies in the Arab Spring, a movement of people in the Middle Eastern and North African countries who were unhappy with their governments. The demonstrations and riots were shared worldwide through digital and social media.

"It's just too bad that the issue of food scarcity comes up against politics… ultimately, it's not a political issue, it's an issue that is about people getting food, and having enough food to sustain their lives."

Cannon said once the messages about food scarcity issues reach the audience, they need to be clear in expressing why the issue is important and how audience members can participate in the issue – sometimes called the "call to action." Cannon said when communicating using social and digital media, issuing a call to action tells an audience how they can participate.

Barriers to reaching the audience

Another challenge in creating effective messages is overcoming language, cultural and political barriers. Cannon said that language barriers include not only the language, but also different dialects. For example, everyday language in the southern part of the U.S. varies from everyday language on the country's west coast. Cannon said when creating messages, people with experience with that dialect need to be involved, so that the message meets the needs and registers with the target audience. Cannon said "It's just too bad that the issue of food scarcity comes up against politics… ultimately, it's not a political issue, it's an issue that is about people getting food, and having enough food to sustain their lives."

ALEC Assistant Professor Karen Cannon meets with CASNR Dean Steven Waller and ALEC Department Head Mark Balschweid.

Technology and Food

Driving Toward the Future of Biofuels and Molecular Nutrition

By Tyler Klein

Paul Black

Fill a gas tank or feed a person? There's a belief that today's crops can only do one or the other. The fact is that researchers are constantly developing new ways to more efficiently use Earth's limited resources.

"The alternative energies are going to fall into essentially two broad categories. One is going to be ethanol, whether it's cellulosic ethanol or non-cellulosic ethanol," said Paul Black, who is the Charles Bessey Professor of Biological Chemistry and chair of the Department of Biochemistry at the University of Nebraska- Lincoln.

Ethanol produced from corn is an example of cellulosic ethanol. This corn-based biofuel has been the renewable fuel that has had the most emphasis in production since 2005.

"The other part of that equation is alternative feed-stocks that can be used for the production of a new generation, or next generation biofuel," Black said.

Ethanol produced from corn has been a staple in the corn belt of the Midwest. It has had several positive impacts, economically because it has helped lower gas prices, and environmentally because it burns cleaner than petroleum.

What consumers might not know is that it also has helped keep meat prices down.

When a bushel of corn is processed at an ethanol plant, two products are made: ethanol and distillers grains. To produce ethanol, the starch is extracted from the corn kernels and broken down into simple sugars. These sugars can then be fed to yeast. A waste product from the yeast is ethanol. Approximately 2.7 gallons of ethanol can be produced from a bushel of corn. What's left of the kernels is a protein dense byproduct called distillers grains that can be fed to animals. Per pound, these distillers grains can be used more efficiently by animals than plain corn.

Essentially, livestock producers are getting a better quality of feed for a lower price. With lower feeding prices, lower meat prices can be maintained, and keeping prices low is imperative to effectively feeding a growing population.

Black believes that the next generation of biofuels will be even more efficient.

New generation biofuels packed with energy

"There's a lot more energy contained within a petroleum product that comes from these new generation biofuels," he said.

Microalgae and camelina are examples of organisms that could produce a new class of biofuels.

"The beauty of the microalgae is that you can put it under stress conditions, such as nutritional stress. That results in the accumulation of oil in the form of triglycerides," Black said.

More energy is packed into these oils because they contain more carbon bonds. Ethanol only has one carbon bond, while the oil product produced from algae has more (e.g. 14, 15 and 16). This means these molecules contain more stored energy, which is released when these bonds are broken.

"Efforts in biochemistry are working towards these next generation biofuels, particularly using algae. In addition, there are a couple of researchers in biochemistry working with camelina," Black said. Camelina is a non-food oilseed crop that can be grown in parts of Nebraska, as well as in other states in the northern Great Plains.

With the population increasing and developing countries continuing to have higher energy demands, Black believes biofuels will be important drivers in the energy market.

"In the long run, 30-50 percent of the overall portfolio of energy might come from these new biofuel sources," said Black. "Down the road, five to 10 years, you're going to see that pretty much as a standard."

Molecular nutrition progresses

Considering the massive quantities of food demanded by the world's population and the immense scales of production required to meet those demands, most people would not consider looking at food scarcity from the microscopic, or molecular level.

Paul Black is involved in research that does exactly that.

"One of the questions we're interested in is how essential fatty acids are specifically taken up by cells, how they're compartmentalized within cells and how they promote health and prevent disease," Black said.

Researchers at UNL are working to understand the metabolic events within cells that allow these nutritional fatty acids to be transported into the cell and compartmentalized for specific functions and how and how these acids are disease-preventing and health-promoting.

"I think everybody needs to be aware of nutritional fatty acids," said Black. "Omega 3 fatty acids in particular are interesting because they are not only essential, but health promoting. If you look at fetal development, for example, the developing fetus has to take up considerable quantities of n-3 fatty acids and get them into their circulation because they're involved in brain development," Black said.

The human brain will not properly develop without n-3 fatty acids. Also, the retina in the human eye will not fully form in the right way because these acids contribute to the architecture of the membrane within the retina. Further, n-3 fatty acids contribute to a variety of signaling events that are anti-inflammatory.

There has to be an appropriate balance of the types of fats that consumers take in.

"We've got to have some of these essential fatty acids in order to maintain our overall health. And at the same time, we want to minimize some of the more detrimental fatty acids," he said.

Limiting intake of saturated fatty acids and trans-fatty acids will promote greater overall health.

Biochemistry's application to agriculture

"There are 21 faculty members in the Department of Biochemistry. Their research efforts address basic plant biochemistry to biomedical research. So we've got a pipeline of expertise that is really quite interesting. At one end, there are faculty members who are evaluating how to modify food crops to enhance nutritional value and on the other end of the spectrum, there are members of the faculty who are addressing complex diseases, including cardiovascular disease," Black said.

With this range of research diversity, researchers can address food scarcity from many different angles. Food production and nutrition can all be examined in the same place.

"There is an additional pipeline at the university that is also very unique. We understand food production, and we understand food processing," said Black. "It's not just about food production, it's also about producing food that has the appropriate nutritional quality to advance human health."

Human health can also be improved simply by understanding what goes into the products that the population consumes.

Black believes it is important to connect the production pipeline with health promotion and disease prevention.

"We have to work from the level of the agricultural producer and the food processor, and we have to engage physicians and the public health professionals," Black said.

Through continued research and education, food production and processing can continue to be improved, which will lead to better health and living standards for the growing population.

"If you just put American ingenuity to work, we can solve the problem," said Black. "I think it's going to be a fun run for the next five years."

Nebraska – the Food Capital of the World?

By Jessica Sorensen

Rolando Flores

Nebraska could be the food capital of the world.

Based on the state's location in the United States and ideal conditions for growing crops, this is possible, according to Rolando Flores, department head of the University of Nebraska-Lincoln Department of Food Science and Technology and director of the UNL Food Processing Center.

"We are perfectly located, we have great growing conditions, we have fantastic soils and we have the know-how and we have the political will to bring Nebraska to the forefront," Flores said. "We have ideal conditions for growing crops…crops that feed masses," he said

Finding ways to use it all

Flores' research is focused on the uses, optimization and development of foods, as well as new uses for agricultural products and their byproducts. Flores said he and other researchers at UNL currently are focusing on finding ways to increase Nebraska's food production, specifically through using everything possible during the manufacturing process.

According to Flores, scientists have been researching new uses for the food that remains after going through the manufacturing process. As an example, Flores explained the increased emphasis on dietary fiber. Twenty years ago, Flores said only 70 to 75 percent of wheat being processed into flour was actually being converted to flour. That meant that the other 25 to 30 percent of the wheat was being used directly for animal consumption.

According to Flores, due to the concern for increasing fiber consumption, more wheat is turned into whole wheat flour, thus 100 percent of whole wheat is used for human consumption.

"Now we value more of the use of the fiber," he said. Faculty researchers are finding ways to use that remaining 25 to 30 percent for human consumption – in products that contain dietary fiber.

"Whatever we are going to process, we try to do it the most efficiently and try to use as much as we can."

Global effort to reduce food scarcity issues

Additionally, food scarcity is another issue that researchers are trying to solve. "It is 'how do we make food available in those places where the food is not available?'" he said.

According to Flores, finding ways to use as much food as possible is one way to help solve the problem of food scarcity. However, Nebraska isn't the only place that is working towards solving these issues. Flores said there are organizations worldwide that also are making the efforts. Flores said the university has a strong interaction with the Indian Institute of Crop Processing Technology (Ministry of Food Processing Industries) where the two groups exchange faculty and knowledge.

India is one country where food scarcity has been an issue. Additionally, it is one of several countries in which the population is projected to increase at a rapid rate until 2050, when the global population will plateau. India's food production is high; however, they are losing 20 to 40 percent of their crop before it reaches the consumer.

According to Flores, on average, India can grow up to three crops of rice a year. Compare this to Nebraska, where extreme seasonal weather variation impacts crop production. In countries such as India, there are different ways that the residents get their food to the market and many of these contribute to food loss. For example, people gather their fruits and vegetables in a basket and take them to the market on foot. By the time they reach the market in the extreme temperatures of anywhere from 90 to 100 degrees, almost one-third of the product is heat-damaged.

As for rice, some people in India thresh the plant by placing the crop on the road so that vehicles drive over it. Although this is a way to thresh the rice, the production loss can be almost half of the crop.

The paddy rice is placed on the roads to dry and thresh it. After a day or so they pick it up, remove the hulls, then bag and store it for consumption later or sell it in markets.

"This is a practice widely used in India and other places in the world; however, it is done to facilitate the processing of the raw commodity – but large amounts of product get lost," he said.

Flores said that the Indian Institute of Crop Processing Technology is working to change these procedures.

"They are already developing their own ways," he said, but added that more and better solutions are needed in the future.

Global imbalance – undernourished vs. obese

At the same time, Flores said not just any food is needed, but nutritious food.

According to a 2011 report from the Red Cross, there are currently one billion people in the world who are undernourished, while 1.5 billion people are overweight. This statistic shows the differences in the diets between societies that are developed versus those that are undeveloped.

"There are a lot of studies that say we have enough food produced currently in the world to feed everyone - the problem is where the food is and where the consumption is," Flores said.

According to Flores, this imbalance is caused by how much energy, such as carbohydrates, are in a person's diet. For example, the United States is a country with a high per-capita income, so people often can afford more food and higher-quality food. As a result, calorie intake is high and because of that, health is affected.

Flores said researchers at the UNL Department of Food Science and Technology are looking into other issues that are created by the extra calories in diets, such as seeing how it affects the digestive system and the gastrointestinal tract.

In the department's Gut Function Initiative, researchers are looking at the evolution of microbiota in the gut. Flores said researchers at UNL are studying it to determine if the microbiota in the gut have changed because of the increased calorie intake in diets, and if so, how they have changed.

Improving health through research

The researchers in the UNL Department of Food Science and Technology also study food allergens, increasing the nutrient levels of foods and creating functional foods with the goal of making people healthier.

According to Flores, one of the goals in the department is not only seeing how to provide food for a global population, but also the food for each individual in terms of nutrition.

"What is that food going to be doing for you?" he said. "How do you stay healthier?"

Flores said there are so many calories in our diets that a person could walk for five miles a day and still not burn all the calories. He said that from any point of view, everyone needs to be conscious of their nutrition because excess weight could affect the joints, sleeping habits and cause associated illness.

"We need to be aware of that and the trends in society are not for less obesity or less overweight, they are more," Flores said.

Researchers at the UNL Food Processing Center, which is part of the Department of Food Science and Technology, are working closely with technical and business development. By offering technical and business development services it allows researchers to help clients such as entrepreneurs, suppliers, retailers and food service providers.

The center is currently working with small and medium-sized businesses to help the businesses develop new products and business strategies. It also offers a training program, including education seminars, workshops and certification programs on subjects such as recipes and food allergies.

Is A Fully-Sustainable World Within Reach?

By Derek Brandt

It is no secret that the planet's natural resources are scarce. It is important for farmers, homeowners and urban landscapes to adopt conservation practices to keep the food supply constant and abundant so a growing population can eat. Using conservation practices is one of the best ways to conserve the resources and reduce the long-term effects on the environment.

"It is minimizing the negative effect of our actions on the ecosystem," said Mark Burbach, an environmental scientist with the School of Natural Resources (SNR) at the University of Nebraska – Lincoln. Burbach directs the SNR Human Dimensions Program, a program that focuses on the study of people and how they affect the development and evaluation of the environment.

"We can have a big impact if we over-use chemicals and not use them properly," Burbach said. "So we want to minimize that and have an appreciation for what our actions and the consequences of our actions are."

Burbach's ideal world would be sustainable – meaning that the world's population could be fed and that natural resources are preserved for the future. It sounds like an idea that is out of reach, but according to Burbach, it can happen.

"Ecosystems are sustainable," Burbach said. "And we can meet our needs for the growing population by minimizing our impact so that our future generations can experience the natural wonders that we currently do."

Conservation practices and cultural values

Burbach studies factors that affect people's adoption of conservation practices. His work explores improvements in farm land, conservation of natural resources, soil and water quality, forests and wildlife habitat, all of which are important to growing successful crops. People connect with nature, according to Burbach, by developing a sort of empathy, or sense of connection to nature.

"For instance, park guides can influence people's connection to nature," Burbach said. "We live in a global world but local decisions matter. Developing appreciation for other people's values is important to natural resource management."

Values vary all around the world, but according to Burbach, the values that show through the most are those of basic human needs, such as satisfaction and appreciation. These values are influential and drive day-to-day behavior. This behavior can sometimes influence the environment.

Mark Burbach

Beliefs about natural resources and how to manage them vary to a certain degree by location, according to Burbach. It is essential to learn what these values are, based on location, instead of making assumptions. Communication is an important tool in learning these beliefs. He said that one can develop an appreciation for other cultures just by visiting and creating dialogue.

"Well, one thing I've done is help with study-abroad trips with students. It is not the same as reading a book about other cultures," Burbach said. "I think that is a good start to meet where you can be face-to-face with others and develop appreciation even if you don't or can't travel everywhere. We develop some appreciation for our similarities and our differences. Respect and communication is important."

The local level

Though traveling and learning about the values of other cultures is important, it is necessary to note that conservation and food-related issues start at the local level.

"Your individual actions, whether it be consumption of products or influence on the environment, we all have an impact on that," Burbach said. "Our local impact can have broader impacts. We contaminate a river and it goes down a stream and it can influence the people downstream. All of these things start at a local level. In Africa, in some cases you can produce a product but you can't get it to the market. That can be a challenge."

As far as what the University of Nebraska has done to enhance conservation practices and implementation on a global level, the Robert B. Daugherty Water for Food Institute (DWFI) has

played a large role. The DWRI is a research, policy analysis and education institute that works to make sure the world is using water to achieve "more crop per drop." The focus is to ensure that there is enough food for future generations.

"It (DWFI) has a presence and a mission that is going to be very important to Nebraskans and the world with water efficiency, water impact and studying human behavior so that we can minimize our footprint locally," Burbach said.

"We've got, all over campus, the research that is being done is critical to our understanding of developing sustainable practices and minimizing our footprint. These are all very forward-thinking opportunities that I look forward to being a part of and I think are going to be great for Nebraskans and the rest of the world."

The institute is the result of a $50 million gift by the Robert B. Daugherty Charitable Foundation. It was established in May of 2010 and researches global efficiency and sustainability of water use in agriculture, quality of water resources and the human issues that affect the water decision-making process, according to waterforfood.nebraska.edu.

"The purpose is how do we focus and feed our growing population and how does agriculture ratchet up so we can meet that growing need for food in the world," Burbach said. "We have to think outside of the box to meet this growing demand for food in the world."

As the world's population approaches nine billion by 2050, conservation and implementation of new policies regarding food will become even more important. Researchers such as Burbach are discovering ways to grow more food than previously possible on a single acre of land, but it may not be enough. This work and research is becoming more important as population grows.

"We need to continue to better understand why people adopt conservation practices," Burbach said. "Clearly, we have been able to grow more food and increase our production and efficiencies. Food production has improved, so that is positive."

On the other hand, Burbach said, there are environmental consequences to all of this. Minimizing these consequences is crucial to ensuring a sustainable planet.

Research and collaborations

Nebraskans have been leaders in developing ways to create more food and better agricultural technology. Finding a balance of energy and research and how to improve efficiency are some of the challenges that face researchers in order to feed an additional two billion people in the not-so-distant future.

"Nebraska has been a leader with our research we have done with global connections," Burbach said. "Nebraska's agricultural products are sold all around. Our irrigation manufacturing is influential all around the world and we've had some of the leading minds."

Burbach attributed some of the progress in research to the University of Nebraska becoming a part of the Big Ten and being able to forge relationships with some of the best research schools in the U.S. According to Burbach, developing collaborations for research is only going to make the University of Nebraska a better place to conduct this type of research.

Some of this research addresses food deserts. A food desert is an area where people don't have easy access to healthy or fresh food. Perhaps it is a long distance to a grocer or urban areas that have a lack of transportation. These limiting factors all combine to create food deserts. Other research topics include how humans impact the environment – and how the environment impacts humans.

"The work that we are doing with our graduate student research is impressive," Burbach said. "We've got, all over campus, the research that is being done is critical to our understanding of developing sustainable practices and minimizing our footprint. These are all very forward-thinking opportunities that I look forward to being a part of and I think are going to be great for Nebraskans and the rest of the world."

Agricultural Efficiency Sustains Resources, Produces More

By Tyler Klein

Roch Gaussoin

An average field in Nebraska consists of 160 acres – a half-mile long by a half-mile wide. Precision equipment in production agriculture can ensure seeds are planted and fertilizers precisely applied, with less than an inch of error. This is one kind of improved efficiency that has benefited the agricultural sector in recent years.

Efficiency in all aspects of agriculture, not just production, needs to be increased in order to meet growing food demands.

"We're going to have to be able to provide more sustenance for a much larger population 50 years from now than we do today, and the University of Nebraska- Lincoln is poised with great scientists, facilities, and support from the administration to do exactly that," said Roch Gaussoin, the head of the UNL Department of Agronomy and Horticulture.

Food scarcity is being addressed from many angles at UNL.

"We have a lot of plant breeders in our department whose sole purpose is developing crops that perform better under adverse conditions," said Gaussoin. "These could possibly be for developing countries that might not have the resources or any of the other technology and support we have in developed countries."

By creating plants with tolerance to weather stresses, such as heat and drought, or pest stresses, producers in both Nebraska and developing countries will benefit.

"We can serve two needs. We can serve the producers of Nebraska. By the same token, we may have a product that can be sent to developing countries or other places where food is scarce, and production is limited," Gaussoin said.

Increasing efficiency in other areas

Even the process of breeding plants with these tolerant traits is becoming more efficient.

"A lot of people don't understand that in the past, it sometimes would take 15-20 years before genetic traits in a crop might be made into a viable product that somebody might be able to use. We're looking at that being accelerated with biotechnology and the capacity to identify traits in a much more precise, accurate, and efficient manner," said Gaussoin.

The University of Nebraska-Lincoln recently received approval for a grant for a system that's going to be built on Nebraska Innovation Campus that can scan plants for certain characteristics – such as grain yield or drought hardiness – quickly and efficiently.

"We're going to be working with plant breeding traits on the molecular level all the way up to production," Gaussoin said. "Ultimately, those traits, or those characteristics, can be bred into a system and then released for use across not only the United States, but worldwide."

It takes the collaboration of many of the departments at UNL in order to produce the ultimate plant varieties, along with crops that carry a certain amount of nutritional value.

"The Daugherty Water for Food Institute is an example of an umbrella institute over the entire University of Nebraska campus involving biologists, plant breeders, and crop management specialists," Gaussoin said.

The term that the Daugherty Water for Food Institute (DWFI) uses to describe one of its goals is "more crop per drop." The researchers involved in the DWFI are finding ways to grow more food with less water by improving crop genetics and producers' management practices worldwide.

"We've come a long way from the idea that we can get more yield simply by putting on more fertilizer. We're better stewards of the land, primarily because of the practices that many farmers do today. They know that their legacy will be passed on to their children and their children's children," Gaussoin said.

Farmers have tried conserving nutrients and moisture in their soil by rotating crops and reducing the amount of tillage. If legumes, such as soybeans, are raised for one year between two corn crops, the soil's nitrogen level will be partially replenished for the next year's corn crop. Also, since soybeans generate less plant residue than corn, there is less of a need to till because there is less plant organic matter that has to be incorporated into the soil.

Researchers have come up with ways to improve efficiency even more.

"No-till or minimum-till operations have been widely adopted. They're also finding out now that the grazing of corn stover by beef is actually putting on more weight gain than they ever thought. Producers used to consider stover as a filler, but when you consider the new data, maybe there's a new way to increase efficiency," Gaussoin said.

One of the problems with no-till operations is that over a period of years, plant residue from previous crops begins to accumulate at increasing rates because it is not being incorporated into the soil. This means that decomposers, or microorganisms that break down dead materials, can only start breaking down residue at the surface.

Cutting edge technologies

Newer technologies currently are being implemented into farming practices to improve efficiency.

Small unmanned aircraft, or drones, can be used with infrared cameras to detect differences in plant colors. Differences in plant colors can be attributed to lack of nutrients or water. Maps can be generated from the information gathered from the drones and these maps can be read by fertilizer application machines. If there is a lack of nutrients in a certain part of the field, the maps will communicate with the machine that is applying fertilizer and the rate will be changed for that specific area. This allows nutrients to be conserved because they aren't applied where they are not needed and are applied adequately in areas where they are needed.

Continuing the efficiency through the land-grant mission

Research technology starts with molecular and genetic studies. It may not necessarily be anything that the producer can plant in the field, but that's always the foundation, or partially the foundation for the development of the end product, he said. The technology might be what the farmer can plant in the field or the increased efficiency of a harvesting device.

"The technology transfer is what's most important. The basis of where we started may not make sense to anybody but the select group of scientists or researchers that work on it, but ultimately it is that transfer of technology that's most important," said Gaussoin.

Technology transfer is included in the land-grant mission at UNL. This mission has three arms: education, research, and extension.

> "We're going to have to be able to provide more sustenance for a much larger population 50 years from now than we do today, and the University of Nebraska-Lincoln is poised with great scientists and great facilities and great support from the administration to do exactly that."

"The extension arm is what takes the research technology that's immediately usable, or almost immediately usable, and gets it in the producer's hands. So that transfer of technology is done via the extension process," he said.

"I really firmly believe that our department is poised and ready to meet the needs of the future population and that's primarily because of the support at the institute (UNL Institute of Agriculture and Natural Resources) level, as well as the university as a whole. It's not just me that's passionate about this," Gaussoin said. "I think most of the people in our department, as well as the Institute at large, are really passionate about what we do and that's as much of a driver as anything."

Technology, Teamwork and Stewardship Vital in Meeting 2050 Global Food Need

By Jaclyn Tan

Based on an interview by Nicole Konen

With the world population projected to reach 9 billion people by 2050, food production must double by then to meet food needs.

That's a big challenge, and one that needs to be considered right now, said University of Nebraska-Lincoln Professor of Agronomy and Horticulture P. Stephen Baenziger, who holds the Nebraska Wheat Growers Presidential Chair for his world-renowned expertise in wheat breeding.

As the primary small grains breeder in Nebraska, Baenziger has bred wheat, barley and triticale to be best suited to growing in Nebraska and to have the highest yield possible. "If you look at the projected rates of gain that they're asking (of) agronomists – people who manage our crops – and breeders – ones who're breeding them," he said, "we are looking at something which is absolutely unprecedented.

"If I were a policy maker, I would say invest in agriculture now," Baenziger said, "because you're going to need it, not today necessarily, but in 10 years from now. Absolutely."

The challenge is made even more difficult because of limited resources such as land, water and fertilizer, Baenziger said. However, he thinks it is possible to meet the 2050 global food need through advancements in genetic technology, efficient management of limited resources and partnerships around the world.

Growth in genetic technology

Baenziger breeds wheat the conventional way: He selects plants based on good physical characteristics, such as high yield or resistance to disease, and crosses them by hand to produce next-generation varieties that will have those favorable characteristics. These crosses are called cultivars.

Advancements in genetics will allow for even more efficient ways of selecting the best characteristics for plant breeding, Baenziger said. "We're living in what is called the genomics revolution, and what that will allow us to do is going to be huge," he said.

For example, scientists have started mapping the genetic sequence of wheat. This knowledge could lead to better understanding of what genes control plant yield and help scientists learn how to breed hybrids with higher yield but that require less inputs, such as water and fertilizer.

Genetic modification, such as the use of transgenes – genes taken out from one organism and inserted into the gene sequence of another organism – also can lead to wheat varieties that have improved qualities, Baenziger said.

Management of limited resources

Although genetic technology can help increase crop yield, Baenziger said the management of land, water and fertilizer are just as crucial because they are limited. "If you think about it, we're not creating new land," he said.

In fact, poor management leads to land that can no longer be farmed. "For every irrigated acre we add due to new water projects, globally we lose about an acre due to salinity," he said.

As a model of good resource management, Baenziger pointed to the Green Revolution that occurred in the 1940s to the 1970s. Researchers such as U.S. agronomist Norman Borlaug, credited as being the father of the movement, came up with disease-resistant, high-yield crop varieties. The era was also marked by the spread of more efficient management methods in fertilization, irrigation and pesticide application outside industrialized nations. Most of the gains will be in well-managed fields, Baenziger said.

Stephen Baenziger

Global and local partnerships

All the advancements in genetic technology and crop management strategies won't help increase crop production if they don't reach breeders and producers around the world. Baenziger said UNL's breeding program freely shares its wheat germplasm, or genetic material, with other breeding programs worldwide because it's a privilege to share knowledge and resources with those who need them most. "Anyone who works on wheat is a friend of ours. That doesn't matter if they are industry, public sector, nonprofit governmental organization," he said.

It also makes sense to share the germplasm, Baenziger said, because wheat was not native to North America. The first wheat that came to the Great Plains came from Turkey, and almost every variety of wheat in the U.S. was bred with germplasm from other countries. "We share our germplasm because people have shared their germplasm with us, and it allows us to create strains that are uniquely adapted to Nebraska," he said. "If (others) can use material to create strains that are uniquely adapted to Kazakhstan or South Africa or South America, all power to them."

In addition to sharing germplasm, Baenziger said he enjoys sharing his knowledge with students who come from all over the world, including the U.S., Thailand, Japan, India, Jordan, Turkey, Costa Rica, Mexico, Pakistan, Bangladesh, Brunei, Saudi Arabia, Egypt, Morocco, South Africa and Ethiopia. "They're the ones that'll be the next generation that, you know, in disparate lands will be making a difference for their countries," he said.

Playing a small role in the big picture

In his 26 years at UNL and as Nebraska's small grains breeder, Baenziger has accomplished much. Besides being the first recipient of the Nebraska Wheat Growers Presidential Chair, he is involved in a wheat yield consortium with the International Wheat and Maize Improvement Center (CIMMYT) in Mexico.

He is the only American on the 15-member board of trustees for the International Rice Research Institute (IRRI) based in the Philippines. He frequently travels internationally and within the U.S. to give lectures.

Despite these accomplishments, Baenziger realizes that he is only a part of a large web of scientists and producers in the race to meet the 2050 food need. He hopes his contributions can help others achieve his lifelong goal of ending world hunger, because in his view, the whole world – including the U.S. – would be better off if there were fewer hungry people. "When you look at countries that are poor, and you look at countries that are trying to become better, we will be more profitable, we will be more safe and we will become a better country if globally, they're wealthier and they're fed better."

"When you look at countries that are poor, and you look at countries that are trying to become better, we will be more profitable, we will be more safe and we will become a better country if globally, they're wealthier and they're fed better."

UNL Research, Extension Help Ag Producers Manage a Changing Climate

By Renee Pflughaupt

Agriculture is complicated. Farmers have much more to think about than just when they will plant or what kinds of crops they will grow.

Technological and scientific advances have made it possible for farmers to optimize irrigation management, fertilizer application and control insect and fungal invasions. Even the crop itself is specialized.

However, said Suat Irmak, professor of biological systems engineering, soil and water resources and irrigation engineering, who also is a water management specialist at the University of Nebraska-Lincoln, "climate is the number one driver of productivity in agriculture."

A farmer can only do so much in the face of climate, even with the best management of soil, irrigation, pesticides, insecticides and herbicides.

"At the end of the day," Irmak said, "crops are going to respond to radiation, air temperature, humidity, wind speed… climate is going to dictate the potential yield for any given crop in a given growing season."

This becomes increasingly important when the world population is expected to reach nine billion by 2050, two billion more than today. Producing food for a growing population will require working very closely with producers to implement the best agricultural management practices in production fields – which is what Irmak sets out to do as both a UNL researcher and extension specialist.

Climate's impact on production, water use

Climate's impact on crop production and water resources, Irmak said, makes it an essential research topic for optimizing crop production.

"Without any question," Irmak said, "climate can be a great enhancer of productivity and can be a huge impediment to agricultural productivity."

Farming strategies can be implemented to mitigate changes in climate variables. But first, he said, one has to understand the trends and magnitudes of change and how it impacts productivity. Only then can a producer make a good decision about what can be done.

And, this requires research. When in doubt, Irmak said, "research, research, research."

For example, Irmak and his research team currently are mapping climate variable trends for the past 120 years in five different locations in Nebraska. This will be used to assess climate variables' impact on water resources and agricultural production.

One of the trends Irmak and his team are finding is that the growing season is getting longer and they are quantifying by how many days. This means farmers may be able to use longer-season maturity crops, which usually produce greater yields.

However, he added, a longer growing season could increase water use, depending on many other factors. This, in turn, will impact the state's water resources and irrigation management.

Investigating the Republican River Basin

So, how much will changing climate variables affect the state's water resources?

Irmak and his research team are embarking on two separate projects, both with the Republican River Basin. One will measure water application to croplands surrounding the Middle Republican Natural Resources District and compare that to the actual amount of water needed by the growing crops.

This will show where too much or too little water is being applied among the selected 50 sites along the basin. Once this is known, Irmak said, improvements to irrigation water management can be made.

Suat Irmak

"Education is everything" – research and extension

All of this research, however, would be somewhat useless without a rigorous extension program to implement the research findings into the practices on the ground. Irmak said Nebraska is blessed to have both a strong research institution and an extension network, which is integrated into the Institute of Agriculture and Natural Resources (IANR) to provide that research to producers and others who will benefit from having it.

"There has to be a strong link between research and extension," Irmak said. "You can't separate them. They have to have a strong connection to make an impact in the real world, in the field."

And research done at UNL is making an impact in Nebraska and worldwide, Irmak said.

"They acknowledge that they are benefiting," Irmak said. "Farmers, crop consultants, natural resource districts, the Department of Natural Resources… as well as in many other states and internationally."

The university also collects data to gauge the impact of its extension and research incentives in the field. One program that does this, and Irmak provides leadership for, is the Nebraska Agricultural Water Management Demonstration Network (http://water.unl.edu/web/cropswater/nawmdn).

The program, established in 2005, includes more than 800 farmers with a footprint of more than one and a half million acres in Nebraska. On these fields, Irmak said, new tools and technologies are used to enhance efficiency and productivity, reducing energy consumption and optimizing irrigation water use.

Technology in the field

Irmak also has seen an uptick in the use of technology by farmers and crop consultants. Many farmers are using smartphones, he said, to control irrigation systems or check soil moisture levels in their fields.

Nebraska farmers are some of the best Irmak knows when it comes to implementing technology or research- and scientifically-based strategies into their practices.

"Once you show them that this information or strategy came from good-quality research," he said, "and if you show them quantitatively its potential impacts, they don't have any problem implementing those technologies into their practices."

This is contrary to what often happens in other states and other countries, Irmak said. It comes back to the University of Nebraska's strong research and extension programs, which Irmak said work very much hand-in-hand.

In contrast, Irmak said many U.S. universities don't have a strong connection to an extension program – and in many other countries, extension programs simply don't exist.

"In this sense," Irmak said, "UNL has a huge advantage."

"There has to be a strong link between research and extension. You can't separate them. They have to have a strong connection to make an impact in the real world, in the field."

Protein Production Essential in Feeding the World

Matt Spangler

China's per-person annual consumption of beef is roughly nine pounds. If that were to increase by just one pound per person, per year, that increase alone would be roughly as much or more beef than Nebraska produces annually. And Nebraska is the largest commercial producer of red meat in the United States.

"Those kinds of numbers are staggering, and are a reality," said Matt Spangler, associate professor of animal science and UNL Extension beef genetics specialist. "The task is pretty evident. We have a lot of protein to produce, and it will come from all species – beef, swine and poultry."

Demographers predict the world population will increase by 40 percent by 2050, but expect that 100 percent more food will need to be produced to meet demand. Included in that demand will be more high-quality protein, such as the meat products produced in Nebraska. Currently, one billion people in the world have access to too much food, while another billion have too little. Food scarcity not only can affect health and longevity, it can create serious political problems.

For some people, meat is either unattainable due to economic constraints, or is simply unavailable. And for those in crisis, "they flat don't care how they get protein. They just want to get it," he added.

Protein, Spangler said, is a fundamental building block of muscle in the body. "Every human needs to consume protein," he said, "and a great source of protein is meat products, be it beef, poultry or pork."

Meat consumption provides other nutritional benefits including fat-soluble vitamins that are in abundance in meat products. "Because of that, I think meat production becomes increasingly important," he said.

Meeting the demand through research

Meeting the global demand for meat products will depend on the scientific research of universities to develop efficiencies in production. For example, research is being conducted in the UNL Department of Animal Science in the areas of nutrition, reproductive physiology, genetics and meat science.

Nutrition research at UNL focuses on the dietary needs of ruminant and non-ruminant animals, with the goal of more efficient production of meat, using less feed. Cattle are ruminant animals, meaning that they have more than one compartment in the stomach. Because of that, they can digest forage, such as grass and corn stalks that other animals can't digest. "Cows can turn what would otherwise be worthless and turn it into a protein resource that we can use," Spangler said. That nutrition research focuses on constantly trying to increase meat quality while improving efficiency. Food safety always is part of the research, he said.

Reproductive physiology researchers at UNL work on improving reproductive rates of livestock animals, which is critical to overall efficiency, Spangler said.

Genetics research, which is Spangler's expertise, develops methodology and technological advances that help livestock producers select for animals that might grow faster, be more efficient and less-susceptible to disease.

Meat science research at UNL not only prioritizes food safety, it looks at new ways of using animal carcasses efficiently. This research reduces waste and sometimes creates new cuts of meat, resulting in variety for the consumer and economic value for the producer.

"All those disciplines work in concert to look at an entire system and how we make a system more sustainable and more profitable, while not ever jeopardizing animal health or well-being," Spangler said. "That's something we take extremely seriously – the well-being of animals."

The well-being of an animal, he said, means that it is not jeopardized in terms of health, has available and adequate food and water and is as free as possible from pain and distress. "Animal production is critical and it is done with best practices and animal well-being in mind. Always."

Efficiencies in production; technology adoption

"Our charge, every day, has been to increase the efficiency with which we produce food, making sure that it's safe, that we don't jeopardize animal well-being and that we don't just discover… we also deploy technology," Spangler said.

"I think that's exciting in terms of what that means for the research discoveries that are going to be made, for the efficiencies that are going to be made," he added.

Spangler's teaching, research and extension work focuses on developing and evaluating beef genetics technologies that

help beef cattle producers improve their beef animals. His research helps producers make decisions that are economically important, as well as important to the well-being of the animals.

Developing technological efficiencies not only benefits Nebraska farmers and ranchers; the technologies can translate to other states and other countries when the technologies are adopted.

"I think a key to technology adoption, using the example of genetic selection tools, is actually to engage producers or industries as we evaluate them for the efficacy, so they can learn by doing," Spangler said. "Then they grow comfort with those kinds of technologies and are more likely to adopt them." Spangler added that other producers tend to follow the "technology adopters," not only here in the U.S., but in other countries, as well.

Climate's impact

"We need to be able to produce animal protein in a variety of climates," Spangler said. Humans control the majority of climate differences in swine and poultry production, as those animals often are produced indoors. Cattle, however, are another story. They are raised outdoors – in Nebraska's hot summers and cold winters.

"We raise cattle in a variety of environments now – extremely hot and humid to extremely cold and dry. And we're able to do that because we can alter feeding regimes, we can alter the breeds of cattle that we use and we can exploit genetic differences," Spangler said.

Researchers in both basic and applied science are working to understand the biological mechanisms that make some animals thrive in one environment versus another.

"With that kind of knowledge, we can easily prepare ourselves for any kind of climate that might face us in the future," he said.

Meaning of the land-grant mission

The land-grant mission of the University of Nebraska-Lincoln often is called the three-legged stool and includes teaching, research and extension, or outreach.

"The land-grant mission means that we really serve the clientele within not only our respective state, but our respective industries – across state lines. And that our research, our teaching and our outreach work is always meant to try to increase the standard of living of what we consider our clientele, which are the citizens," Spangler said.

The extension mission can be considered teaching and learning outside of a formal classroom. Extension specialists, like Spangler, take research findings out to the field and implement them so they can be used by the public and by different industries.

"It's an unbiased educational arm to evaluate technologies and tell producers the best way to adopt them, or if that technology is really the right thing for them," he said.

Opportunities in animal science

Teaching is another leg of the land-grant mission stool. Educating the next generation of animal scientists is essential to continuing the pipeline of researchers and practitioners and encompasses a variety of disciplines. Researchers in the UNL Department of Animal Science could have been statisticians or mathematicians, biochemists or engaged in a variety of other disciplines, but instead are using those skills in animal agriculture, Spangler said.

"Letting students know that there are those kinds of careers available with animals is critical," he said, including students ranging in age from kindergarten on. "Every little kid has a dream of what they want to be when they grow up. I think it's important to teach them there are those opportunities out there," he said.

"If you want to go into animal science as a scientist, if you want to be an agricultural producer, I think now is the time. I think now is at least as exciting as ever," he added.

Nebraska's Irrigation Research Goes Global

By Tyler Klein

William Kranz

Timely access to water can be the difference between a record-yielding crop and a withered field. With the world's population set to reach nine billion people by 2050, potential yield fluctuations like these cannot be left up to Mother Nature's decision on when to make it rain.

Irrigation allows agricultural producers to supplement rain water so they can produce more food and fiber for the world, said Bill Kranz, an associate professor of biological systems engineering and extension irrigation specialist at the University of Nebraska-Lincoln's Northeast Research and Extension Center.

Improving irrigation practices and equipment

"We are blessed with a good supply of very high quality water," said Kranz, referring to the High Plains (Ogallala) aquifer which underlies nearly all of Nebraska.

"Most of what I do is try to improve upon and get more crop from that water. For me it is increasing production with less input," he said.

Kranz tries to help producers achieve greater yields while improving sustainability in the use of water.

> "Most of what I do is try to improve upon and get more crop from that water. For me it is increasing production with less input."

There's an ongoing need to develop new ways of doing things. This can be done by working with new hybrids, or varieties, of corn and soybeans, along with implementing different management practices, Kranz said.

Enhanced genetics, sometimes called genetically-modified, are being integrated into plants. If a producer knows the plants will receive sufficient water through irrigation, that producer can plant hybrids that have higher potential yields than a hybrid that has to be more drought-tolerant in a dryland, or rainfed, setting. Farmers can now average 220 bushels of corn per acre compared to 120-140 bushels per acre in a rainfed field, said Kranz.

Higher potential yields represent a greater chance of satisfying world demand in the future.

New technologies also are helping improve management practices. "Control panels on center pivots allow [producers] to adjust application settings due to soil texture, topography etcetera, and do it precisely. [Producers] are now using technologies like GPS (Global Positioning System) almost routinely," Kranz said.

Along with pivots, farmers utilize GPS by implementing it in many types of machinery including tractors, planters, and sprayers. When GPS is linked into a tractor, it has the ability to drive the tractor through a field with less than a foot of error. It can control which rows of a planter or sprayer are operating so overlap can be eliminated and inputs (seed, chemicals and fertilizers) can be applied more efficiently. With the use of GPS on pivots, irrigating can also be done more efficiently, conserving water and fuel.

This is important because the cost of energy has gone up. It costs significant dollars to put an inch of water on a crop, he added.

But costs such as fuel are not the only reason to strive for better application efficiency.

"Water in groundwater aquifers is a public property," Kranz said. "The NRDs (Natural Resource Districts) have rules that allow them to manage the water that is there."

This means that in some parts of the state, the NRD controls how much water a producer can pump during the growing season.

In order to minimize fuel costs and maximize water efficiency, improvements have been made to the basic irrigation systems.

"There have been improvements in sprinkler packages…we are approaching maximum efficiency related to those. We also have some subsurface drip irrigation systems being installed in the state now, so we are getting a potential for more efficiency out of those," Kranz said.

The improvements in sprinkler packages include the different types of nozzles that can be placed on a center pivot where the water comes out. Subsurface drip irrigation is a newer technology where irrigation lines are placed below the surface and water is dripped to the crop's root zone. This type of irrigation is very efficient because there is minimal evaporation off the soil surface.

A global view

The positive effects of the advances in technology and management practices through UNL have been felt throughout the world.

"Developing countries don't have to go through that development," Kranz said. "Other parts of the world are taking advantage of our technology so they don't have to start at the beginning."

Soils throughout the world must be managed correctly, and developing countries are taking a quantum leap, said Kranz. There are desert-like conditions in some places, and through the use of efficient irrigation, these places can be farmed and more food and fiber can be produced for the global market.

"Water in groundwater aquifers is a public property."

The Plight of the Honey Bee

By Derek Brandt

Marion Ellis

Pollination is essential to agriculture, horticulture production

Since 2006, when a steady decline in honey bee population was noticed, considerable research has gone into investigating the decline, called Colony Collapse Disorder. Honey bees are essential pollinators of various plants in the agricultural system as well as of plants that provide food and shelter to wildlife, plants that control erosion, plants that add nitrogen to the soil, and many plants that add beauty and color to landscapes. Honey bees and their pollination services have taken a hit and researchers are still working to figure out why.

Marion Ellis is a professor of entomology at the University of Nebraska–Lincoln. He has been in the Department of Entomology since 1995 and works primarily with factors affecting honey bee health.

"Colony Collapse Disorder has received a lot of publicity," Ellis said. "The consensus opinion of scientists studying the problem is that there is not a single cause, but there have been a lot of factors affecting honey bee health that have cumulatively filled the cup and spilled over. The biggest being recently introduced diseases and parasites that weren't in this country 20 years ago."

Ninety-five percent of crops grown in the United States require bee pollination. Ellis said that crops like cucumbers and apples are obvious, but noted that even a glass of milk has links to bee pollination. The cattle are fed alfalfa and farmers cannot produce alfalfa seed and grow it without bee pollination.

"It's not just the obvious things," Ellis said. "Most things in our diet, if you trace them, have a link to pollination."

The mite problem

Two mite species were introduced to the U.S. in the 1980s that have contributed to the honey bees' decline in population. A tracheal mite was discovered in 1984 that clogs the breathing tubes of honey bees. In addition to feeding injury it provides a port of entry for viruses and pathogens. "For four or five years, it was a big problem," Ellis said. "It is much less of a problem today due to selection and resistance."

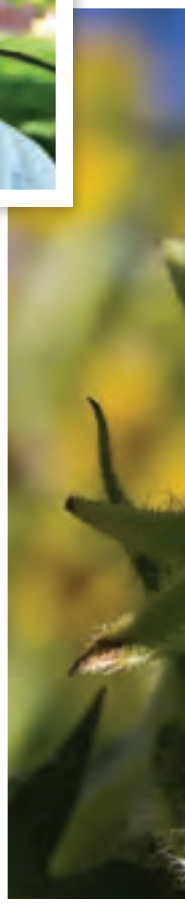
Again, in 1987, another type of mite was discovered -- the varroa mite. These parasites are flat enough to latch on between the honey bee's abdominal segments to suck blood out of the bees, shortening their lifespan, introducing viruses and pathogens, and in high infestations, causing honey bee offspring to be born with deformities.

"It is the biggest scourge of beekeeping worldwide," Ellis said of the varroa mite. "It is a very severe parasite on honey bees. It is native to another species of honey bee that live in Asia, and it is not a severe problem on that species. But on the species we keep in this country, it is a devastating parasite."

Ellis described each mite's mouth parts as being similar to a sabre. The mite pokes holes in the bees in order to ingest the body fluids that leak out, and in the process provide an entry spot for bacteria, viruses and fungi.

"I think there is a pretty good consensus that if the varroa mite would go away, a lot of the other beekeeping problems could fix themselves," Ellis said. "It clearly is the most stressful thing affecting honey bees."

Some honey bees are building up a resistance and it takes longer for the mites to damage them. Ellis stressed, though, that without beekeeper intervention, even the resistant bees will eventually die.



Honey bees won't disappear

With recent trends showing that the honey bee population is in decline, Ellis is quick to dismiss the notion of the bees' population reaching zero. Honey bees are too valuable for their ecosystem services, and current research is providing better tools for protecting and conserving them.

"I think there are a lot of things going on today that have an impact on the honey bee," Ellis said. "Climate change, certainly. Honey bees are fine-tuned to be in cycle with the blooming plant cycle. So there are a lot of things that can affect them in our world. As far as them disappearing from the planet, I think it is safe to say that if they do, we will too."

The treatment issue

In order to combat the mites, beekeepers initially had to rely on miticides to save their colonies. According to Ellis, beekeepers had no choice. They either treated the infestations or lost their colonies. "The miticides saved colonies," Ellis said. "But they also put a stress on honey bees."

Ellis, along with colleague Blair Siegfried, a professor of entomology at UNL, looked into the potential of the pesticides on the honey bee reacting with other things that the bees encounter when foraging or away from the hive and there were some treatments found that should not be used on the bee,

due to these reactions. When pesticides interfere with other treatments, it is called a synergistic interaction.

"We found that when bees are pollinating fruit orchards, and almond orchards in particular, that are treated with fungicide – sometimes during bloom – the fungicides that bees are exposed to can interact with the treatments that the beekeepers are using and cause harm where either one treatment would not be a problem. 'One plus one equals seven' is a good way to think about it."

The effect on agricultural supplies

Honey bees by nature are some of farmers' best friends. They are invaluable to crops that require pollination in order to achieve bloom. According to Ellis, the crops that bees pollinate total $18.7 billion. Nebraska agriculture is not as reliant on honey bee pollination as are other states. Though the Cornhusker State does have fruit orchards and melon crops that require pollination, some agricultural regions are much more reliant on the honey bee. California, for example, grows a lot of almonds, a crop that is heavily dependent on the honey bee.

"In some agriculture systems, like California, where they grow a lot of almonds, they have to be cross-pollinated. Without bees, they can't produce one almond. Almonds are worth six to seven thousand dollars per acre to the growers. So they're currently renting more than half of the honey bees in the United States to be moved to California in February to pollinate that crop," Ellis said.

Before 2007, Ellis noted that the main source of income for beekeepers was honey but that has since changed over to renting honey bees to pollinate the almonds, blueberries, apples, cherries, cranberries and other crops. Almond acreages have expanded rapidly and have become more profitable than producing alfalfa or cotton, which were alternative crops in the central valley of California. In many areas the potential to earn pollination income exceeds the value of the honey that can be produced as growers are competing for the bees they need to make their crops profitable.

"A concern is that they are continuing to expand the almond acreage in California," said Ellis. "It requires less water than some of the other crops and is more profitable. The demand for bees is going up. If we don't come up with some good solutions that allow beekeepers to expand operations to meet that demand, it is going to impact people other than beekeepers."

The University of Nebraska-Lincoln role

UNL is providing many ways to educate people about all things honey bee. Ellis conducts workshops for new beekeepers, and the public also has responded to the news about problems with honey bees by wanting to become beekeepers themselves. "Our participation in those programs has nearly doubled in the last two years," Ellis said. "We have a number of offerings for both beginning and advanced beekeepers that we offer. The value of those is you just need to know a little more getting started to succeed with bees than you did 20 years ago before we had all these issues that have been introduced."

One class on the UNL campus includes students who start their own hives, which they'll take home at the end of the semester. As far as research is concerned, in past years, Ellis spent a lot of his efforts on researching the varroa mite problem. In the last two years, synergistic interactions with pesticides have been the course of study.

What can we do?

The public can do its part to change the direction of the honey bee's population, Ellis said. Planting flowers can help the bee population because the diversity of blooming plants provides food for the bees. The Nebraska State Arboretum has suggestions for which plants to grow for honey bees (arboretum.unl.edu).

Global Goal: Reducing Hunger, Ensuring Food Safety and Nutrition

By Derek Brandt

U.S. programs have unique history, provide a nutrition safety net

Food, air and water are necessary for survival. Thus, it comes as no surprise that as the world's population surges toward nine billion by 2050, food is playing a larger part in global health policies than ever before. In fact, food often is the main focus of government legislation and even has its own organization to educate and pass knowledge through the United Nations: the Food and Agriculture Organization (FAO).

"The focus is to draw attention to the issues of agriculture – and food scarcity would certainly be one of them," said Tim Carr, professor and interim chair of the Department of in Nutrition and Health Sciences at the University of Nebraska-Lincoln. "Its main goal, really, is to reduce the level of hunger worldwide, but the FAO can only act as a dispensary of knowledge and programs and coordinate the exchange of information and practices among nations. It really doesn't have any policing kind of activities."

The FAO was developed and created in the mid-1940s. The organization was intended originally to provide agricultural oversight and address related concerns. Once World War II began, it became more urgent to create an agency with the United Nations that would have more credibility. The FAO, though, does not develop policies for other nations. Nations retain responsibility for creating their own policies. The FAO is simply a guide that can help move a nation toward appropriate legislation.

"The FAO does not create legislation. It can't," Carr said. "It can only make recommendations and share the knowledge of what is successful in one country with other countries. In doing that, it will create conferences and it will hold sessions throughout the year and get people to come together and simply talk and discuss what programs have been working, which ones aren't so successful."

Successful U.S. nutrition programs

Though the FAO lends a helping hand toward successful implementation of food-related policies, it is still up to the countries themselves to create the policies. Some examples of programs that are seeing successful implementation in the United States include the federally-funded school breakfast and lunch program and the supplemental nutrition assistance program (formerly known as the food stamp program).

"The Women, Infants and Children (WIC) targets a special, needy group," Carr said. "So people that fit a low-income category are certainly the target of these programs and can benefit greatly from them."

The WIC program serves those who don't meet a maximum monthly allowance and provides help to those women, infants and children at nutritional health risk. WIC, along with the food stamps program and the school lunch program, are the largest federally-funded programs nationwide. Each state in the U.S. has a varying number of its own policies that are implemented, pending or dead. The United States also holds another key to successful policy implementation and infrastructure.

"In the United States, we have a very well-developed road system and rail system," Carr said. "We have a very well-developed agricultural production system and so guarding against large fluctuations in food availability is what most of these policies really target. So in our country, we have food available year-round. We have an abundant, wholesome, and available – for the most part – food system."

Global infrastructure and other concerns

In some underdeveloped countries, such as Uganda, policies and infrastructure are poorly developed and have a negative impact on food supply, Carr said. Outside of the U.S., large fluctuations in the food supply occur much more often, since the sources of transportation can be less reliable. They also are more susceptible to crop failure and flooding or other natural disasters. Without adequate and complete infrastructure, people may suffer from a less-reliable food distribution system.

Tim Carr

In some cases, depending on population and available arable land, these underdeveloped countries simply may not be able to produce enough food. This causes the country to rely on imports. This reliance impacts the money supply and strains the country's economy. According to Carr, the assistance of other nations in these situations is essential and the FAO may step in and direct the more stable countries to help out.

"Countries that are more developed, they are better economically-able to provide assistance to the countries that are struggling," Carr said. "So it is an area where the FAO now can play a big part by getting the right people connected to the people in need."

U.S. food policy and research, from vitamins to the school lunch program

Carr said the United States has been one of the world's leaders in nutrition policy and research. According to Carr, the past 100 years has been crucial to developing policies, not just for the United States, but for the entire world.

"The United States was one of the first to draft legislation aimed at improving the food supply," Carr said. "In 1906, the Food and Drugs Act was adopted and this was the first case where laws were being developed that required that certain standards were met. And then over the years, for example in 1941, was the year that the school lunch program was initiated. There are many other events that have happened over the years that represent some of the first attempts at ensuring that people had a safe and adequate food supply."

The United States also was among the first to look at the relationships of nutrients to deficiency diseases that occurred because of a lack of those nutrients. The discovery of vitamins also dominated the field of nutrition in the early 20th century.

"I think the first vitamin, aptly named Vitamin A, was discovered around 1906," Carr said. "By about 1950, all of the essential vitamins had been discovered and a lot of that work originated in the United States."

Changing lifestyle requires improved nutrition

Though the United States has been a leader over the years in research and policy implementation, there still is room for improvement. Pockets of the United States still experience a scarcity of food, while part of the population is obese. Those are two areas in which Carr feels like the United States needs to improve. There is a link between low-income families and obesity. One of the main questions is: How do we reconcile those disparities?

"We have gone from a nation of preparing our own food at home to a nation of food that has been prepared by somebody else and in doing that, our food supply has become more enriched in high starch, high-fat kinds of choices," Carr said. "Starch and fat are abundant and cheap. And so the research has shown that low-income families, when they need to find food, tend to buy that which is most cheap and most abundant. Consequently, that can lead to obesity. That is a simple explanation and it is of course much more complex than that and this is where much of the research effort is focused at this time."

> "Countries that are more developed, they are better economically-able to provide assistance to the countries that are struggling."

Society's Health Reflects Changing Food Culture

By Jaclyn Tan

Based on interviews by Nicole Konen and Jaclyn Tan

Food culture defines what people think about food, and is shaped by one's upbringing. It encompasses what one knows about food based on experiences such as what mom made for dinner or what grandma baked for Thanksgiving. "All of us, no matter where we're from, how we got here, we all have a food culture," said Georgia Jones, associate professor of nutrition and health sciences at the University of Nebraska-Lincoln.

But American food culture has changed, Jones said, in such a way that today, most Americans don't know a lot about food or food preparation. Combined with the time crunch from hectic schedules, Americans today are more sedentary, are eating more processed foods and are not consuming enough fresh fruits and vegetables. These practices, Jones said, have contributed partially to rising levels of obesity and diet-related diseases such as heart disease, diabetes and high blood pressure.

What frustrates some people is that having a balanced diet requires knowledge of what nutrients are in different kinds of foods and how to consume these nutrients. "I think a lot of times people want to know what to eat," she said. "And it's not as simple as that, because there's no one way to do it. I think it's about moderation, it's about eating some of what you enjoy, but a lot of it is learning to cook."

Through her appointment as an associate professor and an Extension food specialist, Jones helps people discover the joys of preparing their own meals and learn how to eat a balanced diet without cutting out anything completely.

Two-income households changed U.S. food culture

Dramatic increases in obesity rates within the last 20 years hint at changes in U.S. food culture. In a 2009-2010 national survey, the U.S. Centers for Disease Control found that 36 percent of American adults are obese. For children and adolescents, that number was 17 percent.

In a family, it used to be that only one parent worked and the other could have time to cook and teach children about cooking and nutrition, Jones said. But with the increase of two-income households, where both parents work, there is little or no time to cook. Add to that the fact that home economics has been eliminated from most schools – because of budget cuts or because administrators believed it wasn't important – and "there's just no place for kids to learn to cook anymore," she said.

But Jones does understand that people often don't have time or energy to cook after a long work day. "Most people cannot spend two hours after work to prepare dinner," she said. In fact, most people probably spend about 30 minutes preparing food for dinner, she added.

Georgia Jones

That's why Jones promotes these kinds of easy-to-prepare, nutritious recipes in brochures on UNL Extension's dedicated food website (food.unl.edu) and on her blog, Discover Foods (discoveringfoods.blogspot.com). "It has to be relatively easy to do because most people probably, I would say, spend less than 30 minutes on dinner," she said. Jones said she tries to work in whole grains and fresh fruits and vegetables into her recipes.

Processed foods and larger portions

Because people cook less, food companies also have taken advantage of busier schedules to promote pre-packaged, convenience foods such as frozen dinners, frozen chicken strips, frozen pizzas, instant macaroni and cheese and other similar products. There's nothing wrong with eating those foods once in a while, Jones said, but high consumption of these foods could lead to diet-related diseases such as diabetes, heart disease and high blood pressure. That's because these processed foods are usually higher in fats, salt, sugar and calories, she said.

Food portions also have increased. Restaurant meal portions often are double what an average healthy adult should consume, but most people don't realize that. Things like sodas, which Jones said used to be a treat in her lifetime, have become an everyday food and have almost doubled in portion size. "Soda used to be 8, 12 ounces," she said, "and you know, a 20-ounce soda nowadays is no big deal. If you have several of those a day, that's a lot of calories."

By preparing their own foods, people can control how much they eat at each meal and how much salt, sugar and fat goes into their food. But Jones understands people may be afraid to try new foods if they don't know what it is or how to prepare it. UNL Extension specialists and educators across the state have realized this, Jones said, so many others, like herself, go out to teach Nebraskans how to cook.

After testing out recipes in her lab, which happens to be a kitchen, Jones puts together brochures featuring local produce obtainable at local Nebraska farmers markets or grocery stores. By buying local produce, Jones said, people don't just support local farmers and the local economies; they also can get fresher, better-tasting produce because it hasn't been shipped from far away.

Most people find her recipe brochures online on the UNL Food website, but she also distributes them at farmers markets. Jones said she also conducts cooking demonstrations at farmers markets sometimes. But she hopes she is reaching a lot more people with the brochures than just those who go to farmers markets.

Re-connecting with native foods

Sometimes access to fresh or local produce is a problem, Jones said. Diet-related diseases are rampant among lower-income and minority groups, Jones said, who tend to live in areas where fresh, nutritious food such as fruits and vegetables are scarce.

One group that lives in such areas and suffers high obesity, heart disease and diabetes rates is Native Americans. "I mean, it's almost a rite of passage to have diabetes if you're Native American," Jones said. "It's kind of presumed that you're sooner or later going to get it."

Through a one-year U.S. Department of Agriculture grant through Nebraska Indian Community College, Jones and two other UNL professors Marilynn Schnepf and Julie Albrecht, have been working with Native American families in Nebraska to "help them reconnect with native foods and get a better understanding of their culture through food," said Schnepf, a UNL professor of nutrition and health sciences.

Schnepf and Jones have met four times with 10 families from the Santee Sioux and 10 families from the Omaha tribe. Both groups live on reservations in Nebraska. What they found out from tribe elders is the food culture on these two Native American reservations has changed drastically.

The Santee Sioux used to be hunter-gatherers and traditionally lived off bison and wild plants such as milkweed and chokecherries, Schnepf said, while the Omaha were more agricultural, living off crops that they grew. But they weren't able to farm the same plot of land continuously because they didn't have chemical fertilizers, Schnepf said. "They simply moved on."

Today the Santee Sioux and Omaha have lost their ability to move around and live off the land, Schnepf said. They get commodity food such as white flour, sugar and canned meats from the government and came up with what people today consider a traditional Native American food: fried bread, she said. "It's what they have called traditional Native American reservation food," Jones added, "not traditional Native American food."

Furthermore, the families live in what the U.S. Department of Agriculture calls "food deserts" – areas that lack access to affordable, fresh produce. Food deserts can occur in rural areas as well as urban areas, such as inner cities. Supermarkets or grocery store chains may not want to set up stores in such areas because they might not make a profit due to lack of customers or people who can't afford these products. "Grocery stores live on very small (profit) margins, so they have to do a lot of volume," Schnepf said.

> "We don't cook for the sake of cooking. We cook for the sake of helping you to be healthy."

For the Santee Sioux and Omaha families, the nearest large supermarket is about an hour's drive away, Jones said. Most of the families don't have a car, so they cannot get there easily. "I don't think they want to be unhealthy," Jones said, but they have no choice but to rely on food they can get at convenience stores. This food is similar to what might be found in gas stations, Jones said. They get highly-processed food, such as soft drinks, chips and hot dogs – all of which are laden with additional salt, sugar and fats, Jones said. Produce sold at these places usually has been transported a long distance and looks unappetizing because it is no longer fresh, she added.

To overcome some of these problems, one part of plan is to teach these families how to garden according to their native traditions. Schnepf said the UNL team has gained insight from Omaha tribe elders about a traditional planting method called the Three Sisters, where corn, beans and squash are planted together. These plants work well together because the corn grows tall, the beans can climb up the corn, and the squash grows on the ground and helps with weed control, Jones explained.

When the gardens produce fruits and vegetables, Schnepf said Albrecht, the third professor on the team, will teach the families food safety and food preservation techniques such as canning. Jones and Schnepf also have planned three cooking classes for the Native American families as well. Each participant receives a recipe booklet with simple and healthful recipes focusing on incorporating fruits and vegetables into their diets.

Food knowledge for the future

When Jones is not cooking up new recipes in her kitchen or doing research, she is busy sharing food knowledge to UNL students, many of whom will be the next generation of dietitians and doctors, she said. One of her classes, Scientific Principles of Food Preparation, helps students learn the chemistry behind food preparation. For example, "They know grandma makes a pie crust," Jones said. "They know grandma doesn't put a lot of water in. They know grandma adds fat into it, and then grandma maybe uses lard. Well, my goal is to tell them why."

Students who will become dietitians attend lectures in cultural aspects of food and nutrition. Jones, who is African American and originally is from the southern part of the U.S., gives a guest lecture on African American food: soul food. Because everyone has a food culture, Jones said, it's important for dietitians or anyone who works with food to appreciate the different food cultures that their patients will have.

With the resources available through UNL Extension – the UNL Food website, recipe brochures, food blogs, local produce guides and so on – Jones hopes she and other UNL Extension specialists and educators are doing their part to equip Nebraskans to lead a healthier life. "We don't cook for the sake of cooking," she said. "We cook for the sake of helping you to be healthy."

Steps to Building a Healthier World

By Jessica Sorensen

Food scarcity, food insecurity, food deserts…and obesity?

One in three Americans is obese, but at the same time, many Americans don't have access to the amount or kinds of food necessary for humans to be healthy, according to Jean Ann Fischer, a registered dietitian and assistant extension educator at the University of Nebraska-Lincoln.

According to Fischer, researchers are realizing that there's enough energy, or calories, available to people, but perhaps not the right amount of nutrients for health.

"There's a paradox that we start to see as far as how can we be having rising levels of obesity, yet we still say that maybe there's an issue with people not having access to food," Fischer said. "That's where that food security definition comes in, in terms of do they have access to healthy, safe, nutritious food and what the difference might be."

Fischer said her definition of food scarcity is not having enough food available. However, she said in terms of a domestic problem, people in America have more of a problem with food insecurity. According to Fischer, food insecurity occurs when food is available, but residents might not have access to it. "Access" might include the inability to pay for food or inability to get to a store to buy it.

Food scarcity isn't so much of a domestic issue right now, but it's definitely more of a global issue, she said. Fischer, who is with the UNL Department of Nutrition and Health Sciences Nutrition Education Program, works with educators and assistants who counsel individuals and families on ways to access and prepare safe, healthy food not only for their daily health, but also to help prevent diseases such as diabetes. Fischer said it is getting people to change the habits that can be a barrier, but the key is in finding what's important to them.

Healthy eating, healthy life

According to Fischer, the starting point is addressing basic human needs, such as air, water, sleep and food.

"If you don't have those, you can't move on to the next level. So food in that sense is just a basic survival mechanism we need," she said.

Fischer said some people might look at it as not only meeting basic hunger needs, but being instrumental in their lives for preventing illness and disease and reaching a higher quality of life.

Jean Ann Fischer

Food deserts: another barrier

Fischer said a food desert is not having access to safe and healthy food within a reasonable distance. Much of Nebraska qualifies as a food desert, according to the USDA (www.ers.usda.gov/data/fooddesert/fooddesert.html), as does much of rural America.

According to Fischer, researchers are looking at locating food deserts to identify areas where residents don't have a grocery store within a mile radius, or if there is a grocery store, it doesn't contain safe and healthy food.

Fischer said hunger can sometimes occur because of food deserts.

"If they're in a situation where they don't have transportation and they're 60 miles from the nearest grocery store, how do you get regular, reliable access to safe food?" she said.

In addition, Fischer said researchers have seen a rise in the elderly population struggling to keep food on the table due to rising costs of medical care. She said newly-immigrated residents also have problems with having enough food because they are struggling to find stable employment.

Obesity, lifestyle issues

Fischer said the difference between someone who is obese versus someone who is healthy can depend on daily lifestyle or area where he or she lives.

According to Fischer, a person could think about the causes of obesity as consuming too many calories and not having a balance with burning off those calories.

However, she said a person's lifestyle could affect the ability to work off the calories. For example, if a job requires a person to sit at a desk all day, that person won't burn as many calories as someone whose job requires constant movement.

Also, having a safe environment to be able to go out and exercise is another aspect.

"There's some socio-cultural issues there that if we can provide more community-based feelings of safety for people to have safe access to increasing their physical activity levels, that will certainly help," Fischer said.

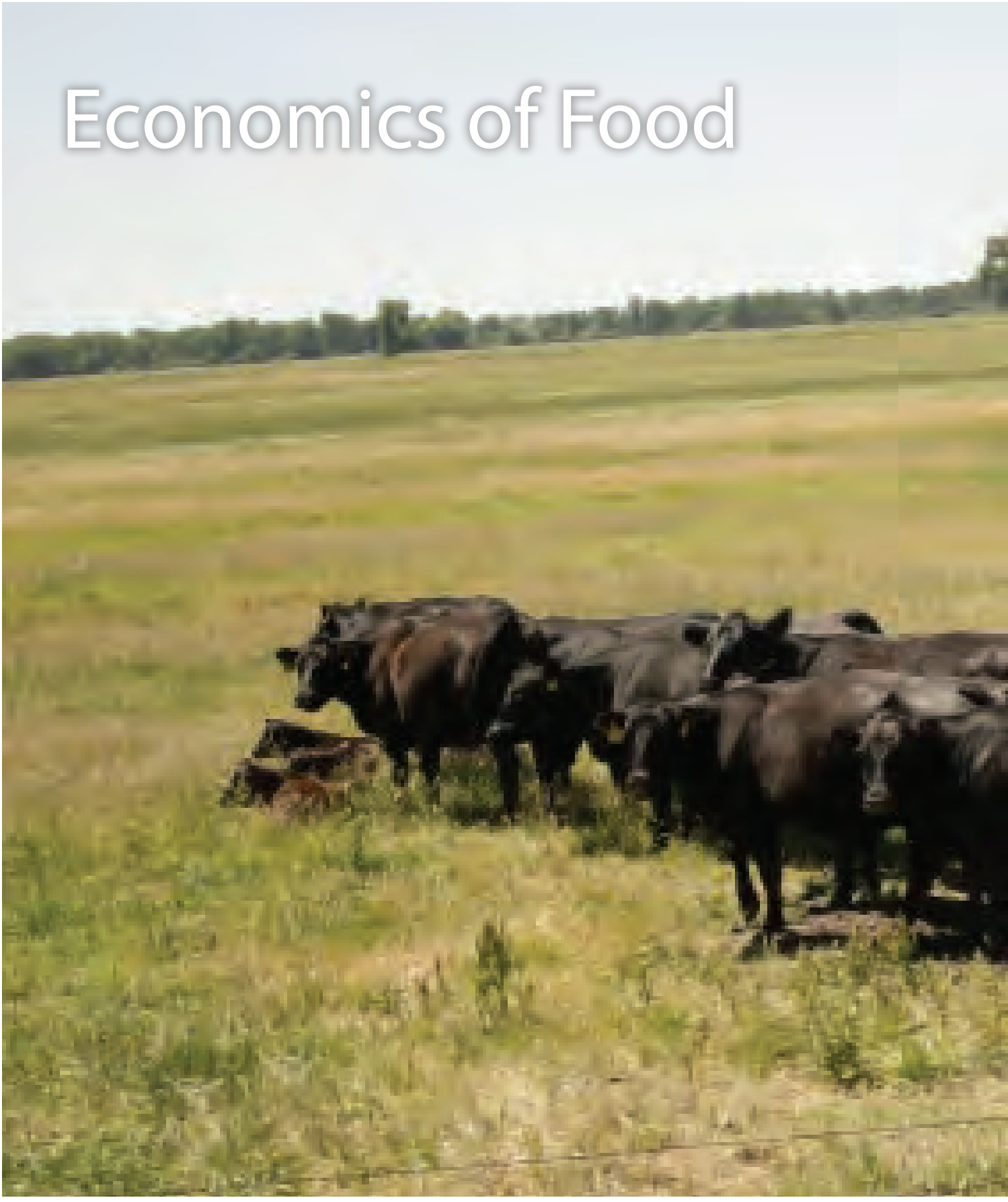
Global collaboration for a healthier world

"At a community level we're seeing more collaboration between all of the different departments, whether it's at the university level, the physician's office, the schools or the Department of Health and Human Services," Fischer said. "If we can get everybody kind of working together on all of those issues and really taking that integrated approach, but yet starting at the family level and the community level and hitting all of the different phases, we'll start to see some improvements."

According to Fischer, this integrated approach can play a crucial role in addressing the nutrition issue globally.

"It's definitely going to need an integrated approach," she said. It will require a broad look at policies, distribution issues and education issues. "It's not just a 'providing food' aspect," she said.

Economics of Food



Ag Economists – Working to Assure Abundant, Safe Food

By Jessica Sorensen

Larry Van Tassell

The great challenge of feeding nine billion people by 2050 means an increase of 40 percent over today's population. But in addition, that population is expected to want higher-quality food – the kind of food that developed countries currently enjoy.

According to Larry Van Tassell, head of the Department of Agricultural Economics at the University of Nebraska-Lincoln, department faculty research includes agribusiness, policy, environmental and resource economics, sustainability, distribution of food, farm management and international economics – as well as offering help so that producers get the maximum value out of their products. All affect the challenge of feeding a growing population.

"Agricultural economics takes in the allocation of scarce resources," Van Tassell said. "Those scarce resources we talk about are capital, labor, land management and we are allocating those among competing ends, in order to produce food and fiber to supply to society both now and into the future."

Van Tassell said researchers need to understand what the consumer wants, and because of that, agricultural economics is a broad scope of study. It is especially important worldwide because of communication and the ways products are exchanged between countries.

"Agricultural economics is a very important area of science," Van Tassell said. "You can take a look at production agriculture: producers must be able to make a profit; they must be able to be sustainable; we must be able to get that product out to the public in order to have that consumed."

But at the same time, "agriculture is a very risky industry, all the way from the variability in the climate, to the variability in supply, demand and prices," Van Tassell said. "And so as a department we have an opportunity of working in all of those areas to help assure that we have an abundant and safe food product for the consumers."

Van Tassell said his definition of food scarcity is not having a large enough supply of food, or the right kind of food, to meet the nutritional requirements of individuals. There may be an abundance of food in some areas, but if it cannot be distributed to who needs it then there is a scarcity of food in those areas.

One way researchers are addressing the population-food challenge is by looking for ways to grow food sustainably. There are agricultural government policies in place to help lower risks involved in agriculture, as well as policies that create efficient energy resources for agriculture and for other consumers.

Ag economists also are studying rural development and innovations that are taking place in the rural areas of Nebraska and beyond.

Today's larger farming operations mean that fewer farmers are needed, so there often is a smaller rural population. As a result, Van Tassell said, it's more difficult to keep the communities operating like they have in the past.

Why Nebraska?

According to Van Tassell, not only is the University of Nebraska in a unique position when it comes to providing food for a growing population, but so is the state of Nebraska. He said Nebraska's diversity in ecosystems gives scientists a diverse laboratory to study efficient production systems from a variety of climates, most of which are similar to climates in other countries. Research in Nebraska can be adapted to those other countries.

Nebraska has a fairly large and stable water supply with the High Plains Aquifer, often referred to as the Ogallala Aquifer. This aquifer underlies nearly all of Nebraska, but also parts of Kansas, Oklahoma and Texas. The deepest concentration, however, is in Nebraska.

Also, Van Tassell said, agricultural industries are well-developed in Nebraska and there is the opportunity to add value to products through those industries.

An exciting challenge

"It's very exciting to be involved in something that is so important to the world with the great goal of feeding the world…nine billion people by 2050," Van Tassell said.

He said it is projected to take 70 to 100 percent more food in order to feed a 2050 world population because people in developing countries are becoming more affluent. With affluence comes a desire for more food and for higher-quality food, including more protein. To nearly double food production, advances in technology must be integrated. He said agricultural economics is the heart of that technology adoption, because it is vital in assessing profitability and sustainability. Van Tassell said it is also important when evaluating what consumers want in a final product and how it translates back into how a product should be produced.

To make progress toward finding solutions to this great challenge, Van Tassell said the department's researchers collaborate with researchers from other departments at the university to find solutions. One example of this research is taking a look at optimal production practices in various commodity areas.

Funding makes the work possible

Some of the funding for research in the Department of Agricultural Economics comes from the commodity organizations such as the Nebraska Soybean Association and the Nebraska Corn Growers.

There also are other organizations that contribute to the costs for the department's research.

"A large part of our funding does come from the USDA and other government agencies and initiatives such as the NSF (National Science Foundation)," Van Tassell said. This funding allows UNL researchers an opportunity to perform research that has implications for Nebraska, but for the United States and the world, he added.

Funding also allows the department to look at beef production systems, as well as what production systems are the most economically efficient. It gives researchers in agricultural economics the opportunity to look at conservation practices to see which individuals will adopt and why they will adopt them.

Department researchers currently are studying how consumers look at food security and food safety and what implications there are to the producers, Van Tassell said.

Researchers also are studying food and energy policies, animal welfare, policies that ensure a consistent food source and what kinds of policies will decrease the dependence on foreign oil.

Worldwide comparisons of the cost of food

Van Tassell said the Department of Agricultural Economics is not only looking at what consumers want in the United States, but also worldwide…and how much they can pay.

A combination of factors make food prices different from country to country. For example, Van Tassell said the price of food could depend on import and export duties and regulations, the supply and demand of food in the area, currency rates and the cost of transportation.

"In the United States we are very blessed to be able to have an abundance of food and be able to spend a lower portion of our income on food," Van Tassell said. "Back in the 1920s, we were spending upwards of 25 percent of our disposable income on food. Today that is only about nine percent," he said.

Compare that to Germany, where consumers currently spend almost 11 and a half percent of their income on food. Or Mexico, where the rate is about 25 percent, according to Van Tassell. He said China's rate is around 36 percent, and some places, such as Algeria and Indonesia, have rates as high as 47 and 45 percent, respectively. "When we take a look at the percentage of income that food entails in a consumers budget, there are two things that contribute to that," Van Tassell said. "First of all, their income that they receive and second of all, the cost of food."

> "It's very exciting to be involved in something that is so important to the world with the great goal of feeding the world…nine billion people by 2050."

According to Van Tassell, the United States has a high per-capita income level and because of that, food can be a smaller percentage of the total income. According to the World Fact Book, published by the Central Intelligence Agency, the 2011 per-capita income in the United States was approximately $48,100. In other countries such as Algeria, where the per capita rate for 2011 was $7,200, or Indonesia where it was $4,700 in 2011, the cost of food takes a large percentage of their income for people that don't make a lot of money.

One analysis that compares the prices of food worldwide is called the Big Mac index. The series is printed in the magazine The Economist and looks at the price of a McDonald's Big Mac sandwich across the world, Van Tassell said.

In January of 2012 the cost of a Big Mac in Switzerland was $6.81 compared to $4.20 in the United States. In Hong Kong the cost was $2.12.

"There's a lot of factors that go into that," Van Tassell said. "One of them is the value of the currencies, the relative value of the currencies between the countries and also in poor countries you would expect a lower price because wage rates and other similar inputs that are less expensive."

Educating tomorrow's leaders

In addition, the department is educating students to address the challenge of feeding the world. According to Van Tassell, it is important that agricultural producers know the economics of the practices they are undertaking so efficient markets are developed.

"We have several academic and research programs and also outreach programs that allow us to be able to help in that efficient production of food," Van Tassell said. "It's very important that farmers know the economics of the practices that they are undertaking."

This importance of knowing the economics of the farming industry is what the UNL Department of Agricultural Economics is instilling in students.

"They are now and will continue to be important in the future as we look at having to feed another two billion people over the next 40 years or so," he said. "The distribution of that food will be very important, and that is definitely something that our students are capable of going out and being able to be an asset to society."

Global Food Scarcity: Definition, Distribution, Roadblocks

By Jaclyn Tan (Based on an interview by Nicole Konen)

Dennis Conley

"One of the reasons we talk about food scarcity and world hunger is that we recognize there are countries of the world, even today – where people for whatever reasons, cannot provide for themselves," said Dennis Conley, professor of agricultural economics at the University of Nebraska-Lincoln.

A shortage of food may happen when not enough food is produced, such as when crops fail due to drought, pests, or too much moisture. But the problem can also result from the uneven distribution of natural resource endowment for a country, and by human institutions, such as government and public policy, he said.

Food – calories and distribution

Food scarcity may exist at an individual level, a city level, state level, nation level, continent level, or even a global level, Conley said.

The World Trade Organization estimates that if total calories from all the food produced were divided among all the people on earth, there would be 2,750 calories per person per day. Since the recommended daily minimum per person is 2,100 calories a day, there are enough calories to feed everyone in the world. But not everyone is getting the need calories and food because it's "not evenly distributed across the landscape of the world," Conley said.

Food scarcity on a global level: natural resource endowments and human institutions

From country to country, the production and distribution of food is influenced by two variables: natural resource endowments and human institutions, he said. The natural resource endowment of a country can include such things as forests, water, fertile land, ore deposits, and a diversity of wildlife. The amount of natural resources a country has determines how much a country can produce for its own people. Human institutions, such as government, public policy and aid organizations, not only set up systems to produce and distribute food, but also to import and export food if there are shortages or excesses.

Conley said some countries, such as Thailand, have both abundant natural resources and efficient human institutions to manage these resources. Thailand produces more than enough rice to feed its own population, so it exports the surplus. "Thailand is a developing country, but it has the natural resource endowments and the human institutions in place to take care of their population."

"One of the reasons we talk about food scarcity and world hunger is that we recognize there are countries of the world, even today – where people for whatever reasons, cannot provide for themselves."

When the natural resource endowment of a country falls short, human institutions can step in to reduce a scarcity of food. For example, Conley said, Japan is an industrialized and developed economy. "But they do not have enough arable land to produce the food, primarily rice, to feed all of their people. And they know that." So the Japanese government – the human institution in this case, he said – provides substantial subsidies and incentives for farmers to grow rice. That way, the country doesn't have to be as dependent on other countries for rice, which is a staple food in Japan.

In the same way, Conley said, the government of Mexico imports corn because it knows the country's natural resources cannot produce enough corn for the population. India and China also import a lot of food to meet their food needs because they have such large populations relative to their natural resource endowment, he said.

Roadblocks in human institution intervention

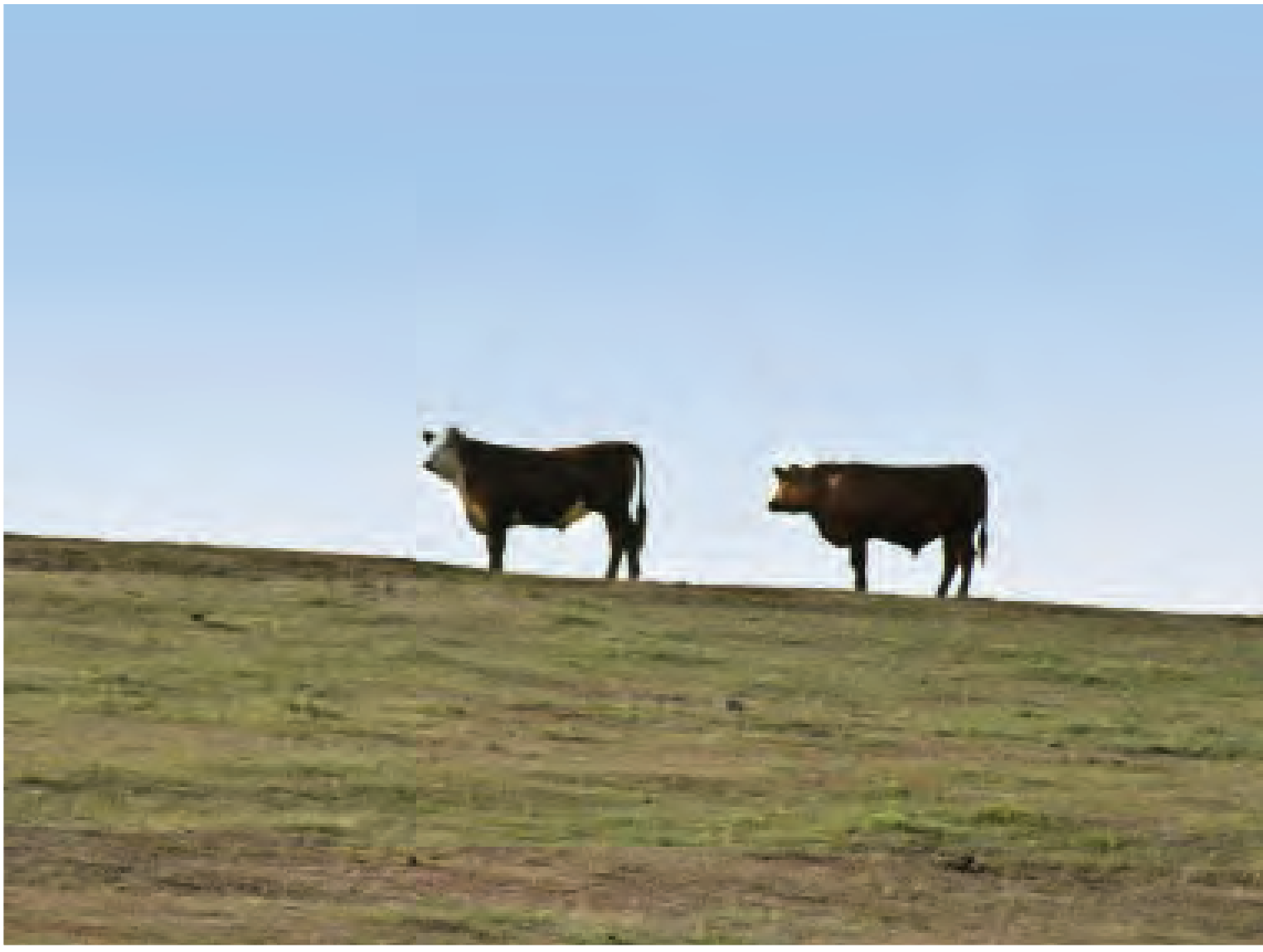
Sometimes other factors make it hard for human institutions to take intervening action to lessen food scarcity. War is one example, as in the case of Somalia, Conley said. Food may not reach certain areas of the country due to fighting and armed conflict, so food scarcity is a problem there, he said.

Another issue with reducing food scarcity on a national level is each country's sovereignty. Even if there were food scarcity issues in a certain country, such as Somalia, "a country has sovereignty over their geographic region and their people," Conley said. So an outside agent like the World Trade Organization or other humanitarian organizations can't help unless the country grants them permission to do so.

Human institutions and food production

Although there may be enough food being produced in the world now, that may not be the case in the future as the world population increases to a projected nine billion by 2050. Conley said technology will be the key in increasing food production. "The amount of land available to do that is limited," he said. "It's got to be technology that does it."

But human institutions often are slow to respond to change, Conley said. For example, seed companies can use genetic modification technology to create higher yield seeds within three years, he said, but it takes up to an additional four to seven years to get U.S. and foreign government approval to market the seeds because they're genetically modified organisms, or GMOs. "My own personal opinion is, it takes too long," he said.



Global Economics Research Explains Food Scarcity Challenges

By Tyler Klein

Lilyan Fulginiti

In a world where there are one billion people who are starving and one billion people who are obese, one might turn to economics to solve the problem of global food scarcity. Global economics can explain why some countries are having trouble obtaining enough food for their populations while others are enjoying too much food.

"Food scarcity has to do with the access that humans have to food. That doesn't mean only the quantity that's there, it means the economic access to food," said Lilyan Fulginiti, a University of Nebraska-Lincoln professor in the Department of Agricultural Economics. Fulginiti's area of emphasis is growth issues in developing countries.

To keep up with the rising demand, agricultural producers must increase production by at least 70 percent before the year 2050. They must achieve this level while at the same time conserving natural resources, Fulginiti said.

"The research that I do tries to discover what the rate of innovation, or productivity, or efficiency change is in the use of resources to maintain the planet in a healthy, sustainable growth path, but still produces the 70 percent more that we need," she said.

"What we do here at UNL –we look at countries that potentially will have the land, the water, where production agriculture is going to be possible in the next 30 to 40 years," said Fulginiti. "We figure out what was the rate of innovation in the past, and what is the potential for the future rate of innovation in these areas."

Agricultural innovations critical; investment needed

New technologies will be crucial in increasing agricultural efficiency in the coming years. During the past 50 years, productivity in the use of resources such as land, labor and capital have improved due to the introduction of new technologies.

"But if you traced the changes in resources such as labor, capital and land in agriculture, they don't explain the big increases in yields. The big increases in yields come from new technologies and practices developed by humans," Fulginiti said.

"Most of these advances in agriculture productivity growth in developing countries have a lot to do with investments in research and development originating in the developed world," she said.

But these public investments have been dwindling over the past few decades.

Decreasing public investments in research and development can already be correlated with decreasing productivity in developing countries, Fulginiti said.

Public investment in infrastructure also must be maintained in order to generate enough supplies to meet demand. Infrastructure is a country's basic physical system, including roads, access to water, and utilities. Infrastructure also includes basic community needs, such as schools and the many kinds of businesses that support one another.

"The same way that public investment in research and development is essential for innovation, public investments in infrastructure is essential to get your crops out," said Fulginiti. "If we see a reduction in that, we will see an immediate reduction in growth."

Difference between food prices, commodity prices

The recent increases in commodity prices have led some to believe they are the direct cause of high food prices.

"One has to differentiate between commodity prices and food prices," Fulginiti said.

Commodities are the basic units that are grown by producers, such as corn, soybeans and wheat. Their prices are determined in the international market due to world supply and demand. An individual producer is too small to influence the price of commodities.

"Food prices are a little bit different because they are determined at the supermarket," Fulginiti said. For example, "the impact of the price of corn on the price of cornflakes is very small. There are a lot of other costs that go into the production of cornflakes, which leads to the price that you pay at the supermarket."

This does not mean commodity prices and food prices are completely unrelated. There is a connection between the two, but that connection is more obvious in developing countries than in developed ones, she said.

"This [impact] occurs for two reasons. One, in the developing world, on average, people spend a lot more of their budgets on food."

With a higher percentage of income spent on food, a rise in the price of commodities would lead to an even higher share of income devoted to food.

"The second reason why it is important in the developing world to look at the connection between food prices and commodity prices is that food are not as processed as in the industrialized countries. Cornflakes are not what you eat, but maybe you eat corn mush. There is less packaging, there are less proportions of other inputs that are not the commodity itself entering the cost of food directly," Fulginiti said.

As a whole, food prices have been relatively low because supply has outpaced demand, due mainly to increases in productivity, until recent years.

"There was a period from 2005 to the end of 2008 which I call the 'perfect storm.' There was a huge increase in prices, oil prices went to $145 per barrel and corn went to $8 per bushel by the middle of 2008."

This scenario can be attributed to many factors, she said.

"There were a number of droughts, for example in Australia, that affected supply. India and China were growing at a fast pace, increasing the demand of protein. All of that, plus the price of oil going through the roof caused these huge increases in the prices of commodities like corn, soybeans, and wheat," Fulginiti said.

After oil prices came back down at the end of 2008, commodity prices stayed high due to the population and income growth. Innovation will be critical in order to again reach the point where supply outpaces demand, she added.

Accessibility to food and nutrients

Not only is it important that there is a large enough quantity of food available, accessibility is another important component in the challenge of addressing food scarcity concerns. Accessibility affects every mode of exchange, from entire countries to individual households.

"An important difference across countries is the policies they implement affecting trade in agricultural products. In my opinion, the single most important trade instrument is the exchange rate policy," Fulginiti said.

The exchange rate is the price of one country's currency in terms of the currency of another country. For example, the price of one United States dollar is approximately 81 Japanese yen.

"If your policy affects the exchange rate so that your currency is very strong, then you won't export much because it costs another country a lot to buy your currency, and this makes exports expensive."

This means that if a country's currency is undervalued, its exports are cheap in terms of the currency of the trading partner. Countries will manage their monetary policies to keep the exchange rate low, and in this way, increase their exports and improve their trade balance.

"A lot of people think that food security means self-sufficiency. Food security is not being self-sufficient because self-sufficiency means closing your borders to food produced more efficiently elsewhere. This can only lead to very expensive food," said Fulginiti. "As an economist, I look at where you can produce the same product relatively cheaper, using less resources. That's where we should be producing it, then trading it, to feed more people."

Income distribution is another factor that contributes to food insecurity and scarcity issues and is one that is directly related to the political will of a country.

> "Food scarcity has to do with the access that humans have to food. That doesn't mean only the quantity that's there, it means the economic access to food."

"We still have people that are nutritionally deficient or that are food insecure because, even if the supply of food is adequate, their material access to it is inadequate. Famine is not the result of lack of food supply, it is the result of political conflict."

Political conflicts not only are an impediment to countries' growth and therefore to the ability of some groups in the population to generate enough income to buy food, but they also impede food aid from getting to the people that need it at the time they need it.

"These circumstances can only be changed by human will through the political system," she said.

Going forward, Fulginiti believes that a crucial factor in food security is supply growth led by innovation, but innovation in a sustainable way.

"This requires not only that we and our trading partners grow sustainably, but that we, as humans, implement policies directed at distributing fruits of this growth in a way in which all have what is needed to survive and live healthy lives."

World Food Supply Adequate, but Poverty is the Problem

Based on an interview by Nicole Konen

Wes Peterson

Currently, there are about a billion people in the world who are malnourished – but it's not because the world food supply isn't adequate, it's because they are too poor to buy food, said Wes Peterson, professor of agricultural economics at the University of Nebraska-Lincoln.

"I think a better way to approach the problem of hunger, rather than trying to think about it as a production problem, is to think about it as a problem of poverty," he said. "Reducing poverty is the way we'll get those people to be fed."

Demographers predict the world population will grow from its current seven billion to more than nine billion people by 2050, creating a substantial increase in the demand for food. People in developing countries are expected to become wealthier and in addition to consuming more food, their desire for higher-quality food, such as livestock products, will increase.

The percentage of the global population living in poverty in developing countries has fallen from 46 percent in 1990 to 27 percent in 2005. It is on track to drop to 23 percent by 2015, Peterson said.

"The problem is that within that very poor group of people there's a very, very poor group and those are the ones that make up about 14 or 15 percent of the world that is malnourished," he said. There are almost a billion people in this group, based on today's world population of seven billion.

Today's food production can feed the world

The Food and Agriculture Organization (FAO) of the United Nations estimates that the number of calories available daily on a per-capita basis (the average number of calories per person) is about 2,800. Those 2,800 calories per person per day are enough for everyone in the world to be adequately nourished.

There are two ways to think about hunger and whether the world is running out of food, Peterson said.

First, will the world be able to generate enough food to feed the larger 2050 population with the same amount of food insecurity (12-15 percent)?

Second, will the world be able to feed the 2050 population with lower levels of food insecurity, or perhaps eliminate food insecurity altogether?

"It will take larger increases in food production if at the same time we want to reduce food insecurity from its current levels," he said.

The FAO estimated in 2010 that 13.5% of the world population was food-insecure. That amounted to 925 million people in 2010 who were undernourished, compared to 1969-1971, when the FAO estimated that 26 percent, or 878 million people, were undernourished. Food insecurity is defined by the United Nations as chronic inability to procure enough food to be adequately nourished.

Challenges

The world population will grow and with income growth, there will be a substantial increase in food demand, Peterson said. If output doesn't increase, food prices will rise. This is true globally – and global food supplies and prices clearly have effects in individual countries. However, for an individual country today, when enough food is produced in the world to feed everyone, food shortages can be counteracted by international trade. Trade, however, can be impeded by transportation costs, government policies and cultural differences.

"There are two kinds of barriers," Peterson said. First, food products have to be moved over distances, from where they're grown to where they're consumed and these transportation costs are added to food prices at the supermarket. Transportation has become much less of a barrier over the years, Peterson said. Efficiencies in the shipping of products have lowered transportation costs in many cases.

Much of today's trade in food and agricultural products is in high-value goods such as meat and dairy products, fresh fruits and vegetables and alcoholic beverages. These goods generally contain a lot of water and are perishable, making them costly to transport, Peterson said. Historically, these goods were not widely traded internationally because of these factors, but today they are, which supports the conclusion that transportation costs have declined.

The second kind of barriers, Peterson said, are the ones that are imposed by governments.

"For most things, trade barriers have been reduced since the second world war, but agriculture's the exception," Peterson said. For example, in Europe, there is a requirement that any genetically-modified commodities have a label so they can be recognized. "That adds to the cost and it's kind of a trade barrier," he said. There also are many more obvious trade barriers, such as import tariffs and export taxes that impede the flow of food and agricultural goods.

Climate, environment

Climate variability could cause supply problems, Peterson said, citing recent examples of droughts in Australia, floods in Thailand and fires in the Russian steppes. The Russian fires destroyed almost the entire wheat crop, he said. Although technology can't counteract fire, researchers are developing plant hybrids that are adapted to the variable climate.

"I'm an optimist," Peterson said. "I think that we will probably put enough resources into research to be able to come up with new technologies." These new technologies will help counteract some of the climate problems, such as drought. Genetic modification of crops is unpopular in some parts of the world, he said. However, technological innovation is going to be essential, both to feed people and protect the environment – and these things are possible, he said, with research.

"Our whole (UNL) Institute of Agriculture and Natural Resources – most of the folks here are working on a wide range of research projects that will lead to increased output in both crops and livestock products," he said.

"I do think that we can increase food output without destroying the environment, but it's going to take some effort. It's going to take some research; it's going to take some technological innovation and it'll have to take some awareness of the problem," he said.

Efficiencies in transportation have lowered some transportation costs.

Ag Land Reflects Value of Growing Food for the Future

Land's value not only in price, but in its food-producing capability

By Renee Pflughaupt

Bruce Johnson

Nebraska is filled with farmland. It doesn't take much to realize it – just cruise along I-80 for a few hours and the evidence is clear: Nebraska is an agricultural state.

But did you stop to think about how much that land is worth?

Dr. Bruce Johnson, professor of agricultural economics at the University of Nebraska-Lincoln, certainly does. Johnson, as part of his research, has tracked the state's agricultural real estate market for more than 30 years.

Only 12 percent of the world's land is suitable for agriculture, consisting of grazing land or cropland. Essentially all of this is in production, he added, with no new frontiers to tap for development.

The worth of agricultural land, Johnson said, is affected by its scarcity and the demand for that land's products. And this demand for highly productive agricultural land will only increase as world's population increases another two billion to reach 9 billion by 2050.

Nebraska, with its strong foundation in research and wealth of natural resources, Johnson said, gives the state an edge to help address this global challenge.

"Nebraska is richly endowed with a natural resource base, to a great extent, unequaled anywhere else," he said.

As the Harlan Vice Chancellor for the Institute of Agriculture and Natural Resources, Ronnie Green, notes, "Nebraska is at the epicenter of food production."

Putting a price on land

Part of Nebraska's natural resource base is its 45 million acres of agricultural land, suitable for growing crops and forage. This equals roughly 90 percent of the state's land area.

More recently, Johnson said, land values in Nebraska have been increasing at a historic rate of over 12 percent annually, or doubling in price every six years.

Not only that, he said, but it is very difficult to even buy farmland in the state. Currently, the annual turnover rate of land is 1.25 percent, less than half the longer-term historical rate.

Nebraska has a large base of agricultural land. But, he said, most land owners are holding on to it. Agricultural land is a precious resource; you can't make more agricultural land than there already is, he said.

"You don't get away from that," Johnson said. "You still need that base of food production."

Feeding a growing world

The amount of land capable of growing food remains the same. That fixed amount, however, needs to produce more food to keep up with worldwide demand. In the face of a growing world population, Johnson said, greater agricultural efficiency becomes a must.

With agricultural efficiency, he said, more food can be grown from the same ground. Or, the correct type of crop or crop strain allows marginal agricultural land to become economically productive.

Land: a shrinking resource

At the same time that countries are trying to secure food supplies, their populations are growing steadily. Demand for food products is growing.

And often, the resources available to grow that food are shrinking.

One of the threats to agricultural land, Johnson said, is city encroachment.

More than 22 million acres of agricultural land in the U.S. have been taken out of agriculture, he said, for urban development.

"And sometimes, ironically," he said, "it's some of the most productive land that happens to be in the path of the urban growth node."

However, Johnson said, Nebraska tends to carefully scrutinize any conflict between agricultural and urban land use.

Much of the protection of agricultural land comes from its

zoning designation. A few acres of farmland cannot just be sold to a person to build a house, Johnson said. By county-wide zoning provisions, which are in place in essentially all the Nebraska counties, the land is reserved for agricultural purposes.

"Food scarcity has to do with the access that humans have to food. That doesn't mean only the quantity that's there, it means the economic access to food."

Producing more with less

Johnson said, food producers need to produce more with what they have. And Nebraska, with its infrastructure in agricultural research, is poised to make it happen.

Many other places in the world, he added, do not have the research capabilities that Nebraska does, thanks to the University of Nebraska's Institute of Agriculture and Natural Resources.

Nor do other universities have such a climatologically or biologically diverse state in which to conduct its agricultural research, Johnson said.

"The variation in conditions across the state," he said, "represents a greater variation than from the Missouri River to the Atlantic Ocean.
"That diversity adds even another mix of richness and challenge and opportunity."

This diversity parallels agricultural conditions around the world, allowing research conducted in Nebraska to benefit other countries.

Johnson said, "Nebraska provides the ideal laboratory for agricultural and food production research."

Strengthening World Economies, Increased Production Key to Food Challenges

By Emma Likens

Eric Thompson

If more economies around the world could sustain solid economic growth, purchasing power for households would increase and "families throughout the world would have the resources they need to purchase food," according to Eric Thompson, director of the University of Nebraska-Lincoln Bureau of Business Research. Thompson said the effort to reduce global food scarcity needs to be about increasing agricultural production, but also on strengthening world economies.

The bureau's research studies local and rural economies and forecasts the futures of these economies, Thompson said. The bureau fulfills university teaching and research missions by engaging faculty, graduate students and undergraduate students from departments throughout the university in economics research projects. Thompson said the role of the UNL Bureau of Business Research is to provide economic information and analysis to the people of Nebraska. He hopes the bureau's research will help encourage the development of policies that will meet state environmental goals, but also in a way that affects agricultural production the least.

Agriculture: the backbone of Nebraska's economy

Thompson said agriculture is Nebraska's leading industry and many other industries depend on it, including manufacturing and transportation. The bureau's research shows how "important agricultural income and production is, particularly in the rural economies of Nebraska but also in the urban economies," Thompson said. Agriculture in rural areas supports manufacturing activity and other industries in urban parts of the state.

During the recession, agriculture did quite well, reaching record income levels in 2011. Thompson called this "counter-cyclical," or an "industry that expands when the overall economy shrinks." While agriculture is not always a counter-cyclical industry, it continues to reach new heights in value and production.

As the U.S. economy continues to recover from the recession, Thompson expects Nebraska's economy to stay strong and continue to improve in the coming years. He expects employment within the state also will continue to improve.

The demand for agricultural products will continue to grow as well, benefiting Nebraska's economy. Thompson said with the growth of the middle class in developing countries like China, India, Indonesia, and Brazil, "It's likely the demand for food products – soy products, particularly meat products – is going to grow quite robustly."

Challenges in population forecasting

Thompson said one of the main sources of error in economic forecasting is population growth. In the last three years, Nebraska's population has grown close to the national rate, but rural communities still are experiencing a loss of population. He said while strong agricultural and manufacturing economies can help counterbalance this population shift, issues related to quality of life make it difficult to attract and maintain people.

"It's likely the demand for food products – soy products, particularly meat products – is going to grow quite robustly."

Services that spur population growth include health care, education, and recreation and entertainment opportunities, Thompson said.

Based on his research, Thompson said the level of taxation, providing government services in a cost effective way and community involvement can help attract and retain population. He encourages local populations to be active in supporting local arts groups and providing parks, libraries, and other services on a volunteer basis to maintain and expand recreational and public service opportunities.

There is No Place Like Nebraska for Meeting Food Challenges

Ibach has confidence in the ingenuity of Nebraska farmers and ranchers

By Emma Likens

Greg Ibach

By 2050, the world's agricultural producers are going to have to grow enough food to feed nine billion people. According to Nebraska Department of Agriculture Director Greg Ibach, some estimates say it will be as soon as 2040. In just three decades, producers are going to have to produce more food in the timeframe forward than has been produced in the history of the world to date. Ibach said while great gains in yield were made during the Green Revolution, these gains are starting to slow. Food production won't be allocated any more land or water; instead, improvements will have to be made in efficiency and drought tolerance. Ibach points to the need of another Green Revolution, fueled by the ingenuity of Nebraska's farmers and ranchers.

Ibach said Nebraska has a great environment for agriculture. The climate allows for disease prevention in plants and animals and the state has an unmatched resource set, from some of the world's most fertile soils to the available water for irrigation of crops. Nebraska also has balance between crop production and the livestock industry, allowing for the fourth largest agricultural economy in the nation.

"When you look at our balance between our crops, our livestock, and the natural resources, we have to be able to produce both of those. I think Nebraska is poised like no other state in the nation, and maybe like no other area in the world, to be able to take advantage of the world's need for food," he said.

Adopting technologies, producing more with less

Ibach attributes Nebraska's positive situation to the farmers and ranchers, who, he said, have proven themselves to be some of the most aggressive producers in the world when it comes to incorporating new technologies into their practices. Nebraska producers embrace technologies from both university based research and multinational companies, allowing them to use less fertilizer, fewer pesticides and less water, Ibach said.

Nebraska's producers may be technologically-advanced in their production practices, but when it comes to telling consumers their story, they're just getting started.

Ibach said that many years ago, "consumers were happy to go to the grocery store and buy what was on the shelf and not really ask too many questions. Now, more and more it seems that consumers worldwide want to know the story about their food and how it was produced." He believes Nebraska has a great agricultural story, centered around the 99 percent of farms and ranches that are family-owned, many for several generations. Ibach said "our wide open spaces, our fertile soils, our clean, clear water, [and] our blue skies those crops and livestock are produced under are all great stories to tell about Nebraska agriculture, and the type of stories consumers want to hear."

Telling the story of safe, wholesome food

By telling these stories and giving consumers confidence, Nebraska can increase local and global demand for their agricultural products. According to Ibach, "consumers need to be confident that the food they have, at whatever volume it comes to them at, is safe."

Even if large volume of food is available but consumers are afraid to consume it, it can't be of any help. The Nebraska Department of Agriculture's programs are balanced to ensure food safety and consumer confidence. Such programs range from regulatory checks at restaurants to requirements for fertilizer and pesticide use. Ibach said once consumer confidence is established, the department can "work with producers to help them produce to those markets, help them communicate their day-to-day activities to consumers, to be able to balance our productive ability with the demand for Nebraska's agricultural products."

Also in telling agriculture's story and inspiring consumer confidence, consumer misconceptions can be avoided. Consumer misconceptions stem from concerns about production practices and can turn into food safety issues and become part of policymaking as nonscientific trade barriers. Some examples of nonscientific trade barriers are concerns about genetically-enhanced products such as corn and soybeans, both of which are grown in Nebraska. These crops are fed to livestock, which then become nonscientific barriers to trade. Although genetically-enhanced products adhere to world scientific standards and are scientifically sound, they are slow to gain consumer acceptance, Ibach said.

"One of the challenges that we face is convincing consumers that we do our due diligence as we develop food products to make sure that they're safe and that we adhere to world scientific standards when we introduce production practices into our agricultural economy, and then that they should adhere to those same world scientific standards to accept our products," Ibach said.

Focusing on opportunities, partnerships, feeding people

The department's focus is on long-term rather than short-term goals, all the while investigating opportunities to meet consumer demands. Nebraska is a largely commercial production state, producing large volumes of food, but the state also has the ability to specialize its agricultural production to meet a specific consumer demand. Some examples are hormone-free beef for the European market, as well as organic products.

"We just need to continue to inform producers about consumers' needs and wants, and at the same time we're informing consumers about the opportunities there are for them to have safe, affordable food in many different offerings. That's the balance we try to strike, informing consumers as well as producing to their needs and desires," he said.

The Nebraska Department of Agriculture works closely with the University of Nebraska to communicate with both producers and consumers and achieve goals both desire to reach. Ibach said the department is able to distribute information to producers through University of Nebraska-Lincoln Extension programs, and the university helps with ensuring that testing procedures are accurate. In return, when the Department of Agriculture is promoting products in a foreign market, they promote NU as a land-grant university and its missions of teaching, research and extension. "We work to get the university exposure to be able to attract more students and be able to also offer their research findings around the world," he said.

Such projects are funded through several different sources, and sometimes combinations of sources. The department receives about a third of its funding from general funds from taxes paid by Nebraskans. It also receives cash funds, which are fees from industries the department regulates. "In a lot of cases, some of our regulatory programs are co-funded between cash funds and general funds, as a partnership between public and private to make sure that we're assuring consumers and producers that our food is safe and wholesome," Ibach said. Funding also comes from federal grants and from Nebraska's commodity boards and their producer checkoff programs. The department works with commodity boards to create programs and invest their dollars in promoting their products.

One example of funding at work is a project being conducted by the Nebraska Dry Bean Commission, modeled after a method used by the U.S. Grains Council. In the U.S. Grains Council project, people globally were educated in how to use corn in the same ways corn is used in Nebraska, especially for livestock feed. The Nebraska Dry Bean Commission is working with the Nebraska Department of Agriculture and the UNL Department of Food Science and Technology on a project with China, which has challenges feeding its growing population. In this project, Chinese are being taught how to incorporate dry beans into their diets.

"We're hoping that by teaching their citizens how to consume a nutritious, wholesome product that they produce right there in China that we'll increase the demand for the Chinese-grown dry beans, and then open up the marketplace not only for the American and Nebraskan dry beans in China, but make more room for us to compete in the worldwide marketplace and be a supplier without the competition that China represents in that marketplace."

"Consumers need to be confident that the food they have, at whatever volume it comes to them at, is safe."

A Land of Plenty – Exporting to the World

Based on an interview by Renee Pflughaupt

Stan Garbacz

Every year, Nebraska produces more agricultural products than it can consume. Those excess products are sold outside the state, creating the strong agricultural economy Nebraska enjoys.

"We really produce a lot of agricultural products… and we need an outlet for them," said Stan Garbacz, agricultural trade representative for the Nebraska Department of Agriculture. Nebraska produces and exports a great variety of products, including grains, livestock genetics, beef, pork, ethanol, distiller's grain and a wide spectrum of food products.

"We're always trying to find ways of selling those products to existing markets to increase the demand there, or try and find new markets," he added.

Nebraska's products are the best, he said. "We raise the best corn. The grains have a lot of deep, rich soils to grow in. And we have an unbelievable water supply," he said. That water supply allows for irrigation of crops, which make Nebraska's ag products especially high-quality.

"Our products are very, very good because of natural resources and because of our people," he said. "Our people are very hard-working; they really care about what they do."

Matching products with needs

Nebraska consumes only a small percentage of what it produces, he said. Much of the food produced in Nebraska is consumed in the United States, but about a third is exported internationally. Garbacz focuses entirely on international efforts to match Nebraska's products with global markets.

People in the greatest need sometimes get that way because they don't know where to go for the products they need, Garbacz said. He travels to countries around the world, visiting with people to help determine what they need and how Nebraska can provide the products.

Global needs exist for a variety of reasons, Garbacz said. In many other countries, much of the agricultural land is being taken over by commercial interests, leaving less land for farming. "We've been fortunate (here) that we have kind of held our own," he said.

Specific preferences, often cultural or religious in nature, also affect global needs. For example, a number of years ago European leaders decided they would not allow imports of beef that came from animals that were implanted with growth hormones, Garbacz said. However, as the European population grew and commercial establishments took over Europe's farm ground, European producers couldn't raise enough cattle or enough grain to feed the cattle. They also have had difficulty finding enough products to import that are not genetically-modified, Garbacz explained. (Genetic modification technology has been used by plant and animal breeders for thousands of years to improve productivity, quality or performance, according to the U.S. Department of Agriculture's Economic Research Service.)

Nebraska's producers, with the help of research from the University of Nebraska-Lincoln and from private industry, have been able to raise cattle without hormones to meet European preferences and sell to that market. It's more expensive, Garbacz said, but it provides the food they need.

"We're not trying to create any products that are going to be harmful," Garbacz said. "We're trying to create products that will enable us to feed the world."

The University of Nebraska and the State of Nebraska, along with private businesses, are working together to create trade opportunities for the state's agricultural products, he said. This includes continuing to work with new and existing clients and creating new products to market and export.

"We have to work with what we're dealt," Garbacz said. Only by knowing what a customer wants, he added, can any beneficial transaction take place.

Edging into Asia's markets

Nebraska's customers in Asia, for example, have rapidly-growing populations, expanding middle classes and a desire for – and ability to pay for –higher-quality food products.

One of those higher-quality food products, Garbacz said, is meat. These developing countries, he said, are consuming a lot of beef and pork. These are very promising markets, he added, for Nebraska livestock and genetics. Still, Garbacz must work with each country's preferences and laws regarding imports of meats and other products.

Garbacz said with each country, he determines what can be imported and by whom, and how to get the people in the country to desire a particular product. There is paperwork required to arrange for logistics of transporting the product to its destination,

whether by truck, train, air or ship. Once the product is there, the proper documentation must be provided – the paperwork – for the product to be accepted into the country of destination.

Regardless of the restrictions a country places on international imports, Garbacz said he and the Nebraska Department of Agriculture find products that each country wants and works with producers to supply those needs.

New products for new markets

Many of those products, Garbacz said, have been created with the help of the University of Nebraska research.

The list includes: raising cattle with few or no hormones; growing feed that eliminates E. coli; developing new methods of food packaging and processing; and creating new food products using dry edible beans, which are grown in western Nebraska.

The university's work in crop hybrids, he said, will be crucial for maximizing the efficiency of available farmland worldwide. "The university is working towards overcoming whatever issues we're having in additional markets for our products," Garbacz said.

Ask anyone in international agriculture, Garbacz said, and they know about the University of Nebraska and the groundbreaking agricultural research it conducts. The innovation happening here, he said, is something Nebraskans take for granted.

"We just assume that's how things work," Garbacz said. "And it doesn't work that way in other countries."

New IANR-Nebraska Department of Agriculture Office in Beijing

On June 11, 2012, the UNL Institute of Agriculture and Natural Resources opened an office in Beijing, China, within the Development and Exchange Center of the State Grain Administration (DEC-SAG). The office was opened in partnership with the Nebraska Department of Agriculture and with Mitex, a private Hong Kong company.

The office, Garbacz said, will allow the State of Nebraska to continue to build trade relationships and find agribusiness opportunities in China for Nebraska companies. For the University of Nebraska, the office will create partnerships that will work toward solving the challenges related to food and natural resource security. It also will promote faculty and student exchanges between UNL and China.

The partnership, Garbacz said, means "our Chinese partners will introduce us as part of them. And then, at that point, we have credibility that we didn't have before."

"It is comforting to know that the best minds are already thinking ahead, planning for and laying the foundations for strategies to feed the world. And many of these minds are right here at the University of Nebraska–Lincoln."

--Harvey Perlman, Chancellor, University of Nebraska – Lincoln

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"If we embrace the responsibility of being one of the leading land-grants in agriculture, then I think our students also must accept the responsibility of contributing to the solutions globally."

--Steven Waller, Dean of the UNL College of Agricultural Sciences and Natural Resources

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"The land grant (act) created these wonderful colleges and universities across the country to give every person an opportunity to have a higher education."

--Elbert Dickey, who retired in June 2012 as UNL Extension Dean

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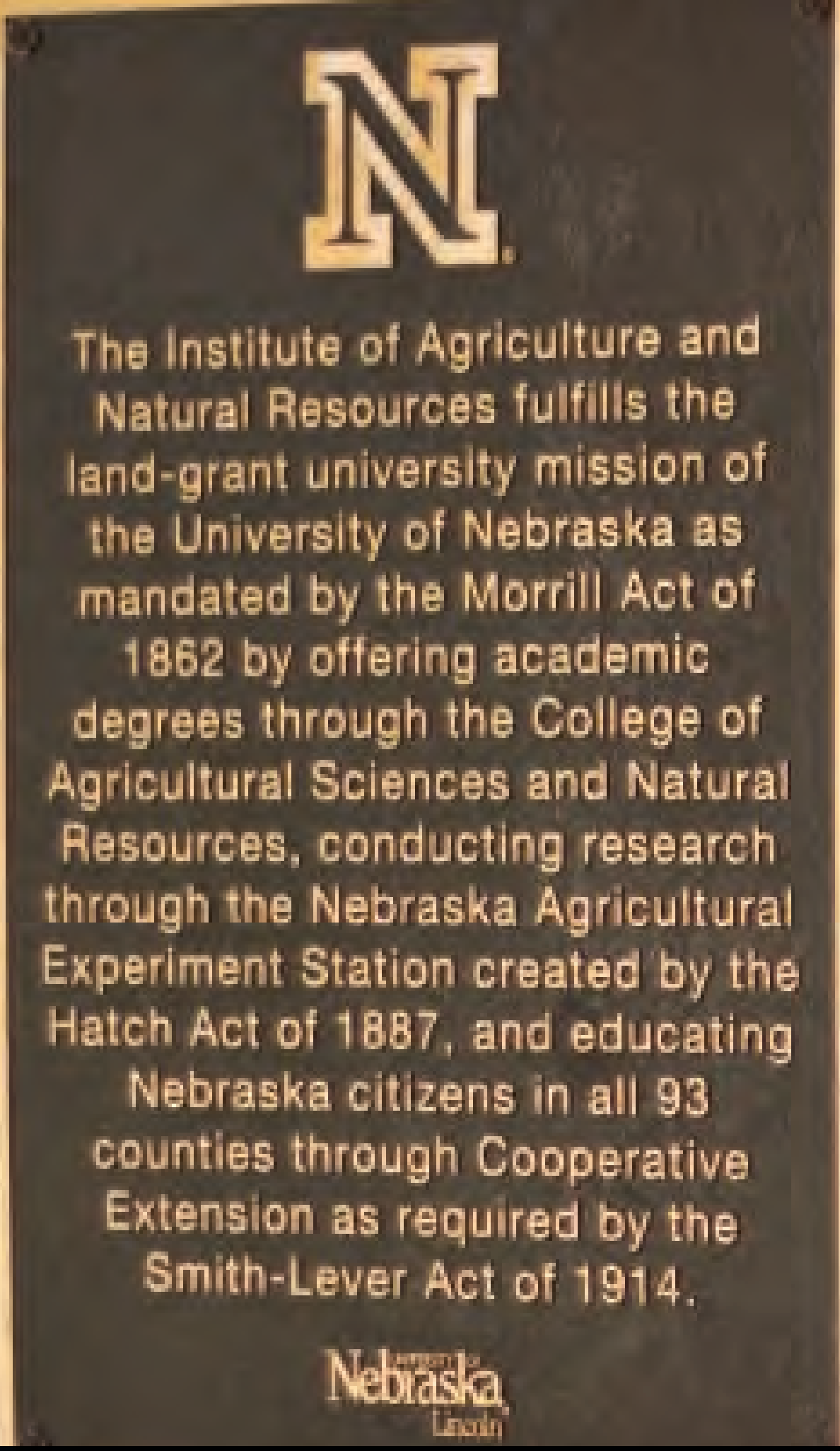
"The land-grant mission means that we really serve the clientele within not only our respective state, but our respective industries, across state lines. And that our research, our teaching and our outreach work is always meant to try to increase the standard of living of what we consider our clientele, which are the citizens."

--Matt Spangler, associate professor, UNL Department of Animal Science


The Institute of Agriculture and Natural Resources fulfills the land-grant university mission of the University of Nebraska as mandated by the Morrill Act of 1862 by offering academic degrees through the College of Agricultural Sciences and Natural Resources, conducting research through the Nebraska Agricultural Experiment Station created by the Hatch Act of 1887, and educating Nebraska citizens in all 93 counties through Cooperative Extension as required by the Smith-Lever Act of 1914.
University of Nebraska Lincoln

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