2017 University of Nebraska Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 06/14/2018

I. Report Overview

1. Executive Summary

The Institute of Agriculture and Natural Resources (IANR) is a part of the University of Nebraska-Lincoln and includes the divisions of teaching, research, and extension. Strategic planning is integral to IANR's function as a land-grant institution, and it prides itself on working as an integrated system and collaborative environment across the three mission areas. To ensure that IANR's priorities reflect the needs of the state's residents there is on-going, two-way dialogue between IANR and the residents of the state. In 2011 strategic two-way dialogue moved to a new, higher plane as Vision for 2025 was implemented to ensure Nebraska's competitiveness in a world of change and challenge. This visioning process was created to determine how IANR will contribute to the critical need of doubling the world's food supply in order to feed 9 billion people; address the shifting climate and environmental conditions; respond to the increasing need for energy sources; and consider how to help increase economic income opportunities for communities. In Nebraska, one in four jobs is directly tied to agriculture or agribusiness, and the state strives to increase job opportunities in this field of expertise. As a result of the visioning process, the priorities of IANR became food, fuel, water, landscapes, and people.

The future of Rural Communities is a crosscutting thread in each of these five issue areas. The importance was highlighted in 2013 by the establishment of a University of Nebraska system-wide initiative, the Rural Futures Institute (RFI), and the hiring of its executive director and support staff. Nebraska Extension established a new community-focused faculty team called the Community Vitality Initiative for the purpose of partnering with RFI and Nebraska communities.

Recent conditions have proven challenging for many agricultural producers. In response to the economic downturn, Nebraska Extension developed and launched an initiative focused on strengthening Nebraska's agricultural economy in 2017. Research-based information from across multiple disciplines is helping producers reduce input costs, increase efficiencies and improve productivity of farm operations.

The Vision for 2025 is a guide for IANR for the next decade. Engagement with Nebraska government leaders, stakeholders, representatives of organizations, faculty and students/youth continues. Listening sessions, surveys, departmental reviews, and input from advisory groups maintain public involvement.

These priority outcomes of food, fuel, water, landscapes, and people are representative of the societal challenge areas of the National Institute of Food and Agriculture (NIFA). For example, in the Nebraska planning process "food" represents the continuum of food to fork, which includes production, food security and hunger, childhood obesity, nutrition and food safety, and science/food literacy. Food Production/Security and Landscapes represents the productivity and sustainability of all of our natural resources. Water is highlighted because of the importance of water to our agricultural and natural resource systems in Nebraska. People and Their Well-Being represents the well-being of children, youth, and families as they interact with their environments.

The Institute of Agriculture and Natural Resources continues to strive to meet the needs of its Nebraska citizens through engagement in internationally-recognized science and education. This mission is being

met by: advancing knowledge along a continuum from fundamental research to application; delivering education that addresses the current and emerging needs of the state's residents; and teaching tomorrow's professionals through formal and nonformal learning settings. The ongoing cultivation of public-private partnerships helps make our mission more achievable.

The importance of integrated missions is evident in the continued upward trajectory of grant/contract dollars received, the rigor/impact of educational programs delivered in both formal and nonformal settings, and in the placement of graduates in careers.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	228.0	0.0	140.0	0.0
Actual	220.4	0.0	156.1	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- External Non-University Panel
- Combined External and Internal University Panel
- Combined External and Internal University External Non-University Panel

2. Brief Explanation

Interdisciplinary extension issue teams, comprising faculty representing interest groups (beef systems; 4-H youth development; the learning child; community vitality initiative; cropping and water systems; food, nutrition and health; community environment, reaching one, reaching all; next generation extension; and disaster education), update their team plans annually using stakeholder input and evaluation results from delivered programs. Also, every faculty member with a research appointment in the Agricultural Research Division (ARD) has a current approved peer- reviewed project that defines his or her area of research investigation. The peer review process for research projects includes the Unit and (if applicable) Research and Extension Center head, at least two faculty members with relevant expertise, and an Associate Dean of ARD. Following review and acceptable revision (if necessary), the project outline is forwarded to USDA-NIFA for inclusion in the REEport database.

Another review process, which combines merit and peer review, is the annual review of more than 100 research and extension proposals by state commodity check-off boards. Proposals selected for funding address the most significant problems facing the producer members and clearly communicate the research's relevance to user needs. Academic units (subject matter departments and research and extension centers) complete a comprehensive five-year review to ensure program quality and relevance. Teams of three to six external panel members and two or three faculty panel members from other academic units conduct these reviews. The review team assesses the work of the academic unit to ensure that programmatic efforts and research focus on Nebraska's most critical needs. The review team completes its assessment by the development of a report that helps the administrative unit focus its work for the next five years. It is the responsibility of the IANR Deans to assist the unit administrator and faculty

to accomplish the goals identified by the unit, as a follow-up to the review process. Stakeholder input remains key to IANR success throughout the process mentioned above.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Targeted invitation to traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public
- Other (Development of public value statements for use by stakeholders to promote IANR programs)

Brief explanation.

Ongoing input from stakeholder groups, e.g, advocacy, advisory, and commodity groups, keeps extension team plans current. Ongoing relationships with stakeholder groups such as the Agriculture Builders of Nebraska and Family, Youth and Community Partners, along with listening sessions led by IANR personnel and extension board reviews of local and regional programs, ensure that critical needs are addressed. Continuous listening processes ensure that the plan of work is reviewed and updated regularly. The accuracy of the teams plans is verified using the following methods:

- Extension issue teams meet regularly to assess their goals and progress made toward achieving them. Teams include both faculty of academic departments who understand long- term trends and faculty located in extension offices who see, on a daily basis, the needs of Nebraska residents. Many of these faculty members of academic departments have joint research and extension appointments and can represent fundamental as well as applied research and extension education plans.
- Many issue teams use monthly phone and/or video conferencing to stay on track.
- Issue team leaders talk with subject-matter department administrators annually to ensure that the issue team's goals are congruent with university department research and extension goals.
- Issue teams meet with their stakeholders to garner input to determine future plans.
- Issue teams refine programs to ensure that content goals support needs identified by stakeholders and demographic trends.
- Extension-developed public value statements used by stakeholders tell others of the impact/public value of extension and then seek input for programmatic direction. (Go to: http://extension.unl.edu/impact/ to see 'Impacting All of Nebraska' impact summaries). Impact reports are available online and printed annually for each issue team (and related areas); each includes a public value statement, which helps stakeholders understand the value of and differences being made by today's extension/research programs. Impact reports and public value statements are given to decision-makers and extension board members to help guide their advocacy efforts on behalf of IANR at the local, regional, and national levels.
- ARD faculty currently participating in multistate projects receive research funding through the multistate research component of the federal formula funds. These projects are selected and approved by regional director associations because they are high priority needs identified for multistate activity.
- ARD internal competitive grant funding includes external stakeholder review.
- The IANR fall summit, "Growing Nebraska: Leveraging Partnerships, Programming and Research" invited stakeholders to discuss critical issues in Nebraska and motivated individuals to join together to find sustainable solutions, while thinking globally and acting locally.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use External Focus Groups

Brief explanation.

Nebraska is a state in which the public is very engaged with its university; the number of individuals who each year step forward to engage with IANR is commendable. Research and extension's strategic relationships with local, state, and federal decision-makers is valued. Advocacy groups, advisory groups for subject matter, departments, research and extension centers, and extension boards are utilized to gather input. Farm organizations and industries related to agriculture routinely are at the planning table. Below are examples of how research and extension address the needs of underserved and underrepresented populations.

• ARD research programs related to human nutrition and healthy lifestyles were highlighted under the federal goals and key themes. The research results feed science-based information directly into Nebraska Extension programs that target underserved and underrepresented populations. ARD is initiating partnerships with Nebraska Indian Community College (NICC) and Little Priest Tribal College for preserving nature, cultural practices, and maize varieties.

• ARD is in the beginning stages of developing an external advisory committee that will include multicultural membership.

• Nebraska Extension has built a strong partnership with Little Priest and NICC. Through this partnership, Native American teens have become more involved in outside activities and interact with youth and adults outside their schools. Program leaders say teens are more motivated and more interested in learning about activities. The Expanded Food and Nutrition Program and the Food Stamp Nutrition Education Program annually teach low resource families and youth (many are from the underrepresented populations) how to make nutritionally sound food choices, use their food dollars wisely, and cook meals for their families that adhere to food safety principles.

• The College of Education and Human Sciences, extension and the Nebraska Department of Education have undertaken a programmatic effort with targeted school districts to address needs of first generation families.

• An extension educator addresses the needs of Hispanic and Native American youth in Scotts Bluff County. This program engages middle and high school youth in after-school and community-based programs. Coalitions of Hispanic and Native American individuals contribute to the success of this youth program. An extension educator in northeast Nebraska is connecting Nebraska Extension youth development programs with Hispanic and Native American families in this region.

• Ongoing efforts to recruit and retain a more diverse pool of faculty that can serve as a gateway into underserved and underrepresented populations are underway.

• In 2013, IANR participated in a Civil Rights Review through USDA NIFA and has developed or started several new initiatives to improve connections with underserved audiences. One direct outcome is a $100,000 extension-funded competitive grant program for proposals that reach new audiences. A summary of our commitment to a diverse faculty and diversity of audiences reached by our education programs is found at: http://ianr.unl.edu/diversity

• Nebraska Extension is committed to ensuring access and opportunity for all Nebraskans to receive, and benefit from, our programming. We will demonstrate excellence in valuing everyone as an important member of the communities that we already serve and those we seek to serve. Nebraska Extension began with two pilot sessions, "Navigating Difference (ND) Multicultural and Diversity Training and Intercultural Development Inventory (IDI)." The success of these pilot sessions has led to training three more extension faculty as facilitators and offering at least three trainings per year, which includes individual coaching sessions for all participants.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

In 2015, the Nebraska Extension Directions Group, consisting of seven extension faculty from each of the major seven interest groups (programming content areas) and four extension program leaders/administrators, assembled a list of key informants from strategic agencies and organizations. Interviews with key informants were conducted by members of the Directions Group to inform the development of draft issues. The Directions Group subsequently refined the list to approximately 35 issues. Online surveys for the prioritization of the issues were sent to faculty across the state with instructions for the faculty to distribute the survey link to a wide variety of constituents between late July and early August 2015. Approximately 1,900 stakeholders responded to the survey with their assessment of the priorities of the issues. Responses were received from stakeholders as follows: 21% urban (communities >150,000 population); 19% midsize (communities 5,000-150,000); 20% small (communities <5,000); 26% farms; 15% acreages. All age ranges were represented. The Directions Group further refined the list of issues based on stakeholder priorities. The refined list was reviewed by the Nebraska Extension Leadership Team and a final list of issues was confirmed, resulting in the development of 18 multi-disciplinary Issue Teams by December 2015.

Another method of collecting input from stakeholder groups was through face-to-face meetings. Additionally, there was an ongoing effort on the part of extension boards to talk one-on-one with their neighbors and colleagues about needs within their geographic regions.

Extension is a partner with the 1994 land-grant institutions in our state. Extension and the Nebraska Indian Community College (NICC) have had a continuous partnership to support the implementation and management of Tribal College extension programs in three different NICC communities. IANR extension faculty who work routinely with the Tribal colleges serve as a conduit to move content and planning information between these entities. Research opportunities are also being explored with these colleges.

The Nebraska Panhandle has both recent and longtime Hispanic residents. An extension educator in the Scottsbluff area works with audiences and local planning groups to ensure a cross-cultural understanding. The program is in three parts: history of Mexican people in the Panhandle, cross-cultural communications, and formal education for audiences working with English language learners. This workshop is presented for public school educators, health professionals, students in education, health and human services employees, community leaders, chambers of commerce members, and companies. This is just one example of extension's engagement as a teacher for other organizations who seek increased understanding and involvement with all of our state's

residents. In addition, Nebraska is working to increase the number of extension educators who can target diverse youth audiences. For example, a Spanish-speaking 4-H educator works specifically with underserved audiences in northeast Nebraska; this educator reached over 11,950 people in the past year.

Nebraska Extension continues to partner with Iowa State University on a joint educator position. This person is working on business development and youth entrepreneurship, focusing on Latino audiences in the Sioux City, Nebraska, area.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

Input from stakeholders is used to identify emerging issues for both research and extension, and to help set priorities. Stakeholders are also invited to provide input during the selection of administrators; for example, stakeholders serve as members of search committees for unit administrators, deans, vice chancellors, etc. Local stakeholders are invited to interview extension educators for positions located in their geographic regions.

Brief Explanation of what you learned from your Stakeholders

Stakeholders expect IANR and its divisions of research, extension, and teaching to remain focused on critical issues facing Nebraska. They expect the land grant institution to do cutting-edge work that is well regarded by the academy, has global impact, and is of value to Nebraska's residents and economy. Stakeholders recognize that programming priorities must be established. During 2015, 18 extension issue teams were developed from the direction of our stakeholders to address the issues and needs of Nebraskans. In addition, 10 interest groups have formed under these issue teams to directly develop research-based programs and information that will positively impact these stakeholders, allowing them to make informed decisions relevant to these issues.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	4855873	0	5013089	0
Actual Matching	5122004	0	4370496	0
Actual All Other	0	0	0	0
Total Actual Expended	9977877	0	9383585	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	959408	0	1461568	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Food Production/Security and Landscapes

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%		9%	
111	Conservation and Efficient Use of Water	8%		9%	
112	Watershed Protection and Management	4%		5%	
132	Weather and Climate	5%		3%	
133	Pollution Prevention and Mitigation	4%		6%	
136	Conservation of Biological Diversity	0%		3%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		8%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	3%		5%	
205	Plant Management Systems	23%		4%	
206	Basic Plant Biology	0%		4%	
211	Insects, Mites, and Other Arthropods Affecting Plants	4%		5%	
212	Pathogens and Nematodes Affecting Plants	3%		8%	
213	Weeds Affecting Plants	4%		5%	
301	Reproductive Performance of Animals	1%		3%	
302	Nutrient Utilization in Animals	1%		6%	
305	Animal Physiological Processes	0%		5%	
307	Animal Management Systems	28%		3%	
311	Animal Diseases	2%		5%	
601	Economics of Agricultural Production and Farm Management	9%		1%	
605	Natural Resource and Environmental Economics	1%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	152.0	0.0	129.0	0.0
Actual Paid	131.7	0.0	135.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
2978182	0	4262136	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2982079	0	3860518	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Conduct foundational research in the basic sciences that underpins and will support future productivity and sustainability advances in agriculture and Nebraska's environmental resources.
• Conduct research and extension programs to develop and deliver new and improved crop and livestock integrated management programs that increase the potential for improved agricultural productivity.
• Conduct research and extension programs to develop and deliver new and improved information to help producers create sustainable crop and livestock production programs.
• Conduct research and extension programs that will help characterize and maintain the High-Plains ecosystem, and better understand the potential impacts of climate variability and change.
• Conduct research and extension programs that help citizens mitigate the impact of water stress (excess and insufficiency).

2. Brief description of the target audience

Nebraska farmers and ranchers, along with landowners, are the primary target audience for this work. In addition, target audiences will include land managers, bankers, agricultural consultants, and agribusiness professionals who provide products and services to farmers and ranchers. The program's research and education efforts will provide valuable information for state and local policy makers (especially Natural Resource Districts' boards of directors) as they make decisions regarding natural resources and climate issues. The program will provide agency staff with the knowledge they need to carry out agency responsibilities and mandates.

3. How was eXtension used?

All of our faculty are asked to apply for an eXtension email and become a member. eXtension continues to serve as a valuable resource for clients and faculty. For subject areas outside of our focused areas of work, it provides a primary web resource used by faculty and clientele for land-grant university information. For example, eXtension is our primary land-grant web resource for subject areas such as farm safety, freshwater aquaculture, goats, and grapes, all topic areas for which Nebraska Extension provides little or no web content. In addition, Nebraska Extension websites link to eXtension, and eXtension serves as a resource for faculty in answering questions and providing supplemental resources for face-to-face training sessions. Nebraska Extension faculty also use the training and resources of eXtension to expand their skills and expertise in efforts to better serve clientele.

In 2017, Nebraska citizens using "Ask an Expert" asked 245 questions with 160 responses provided by 64 Nebraska Extension faculty; 94 "Ask an Expert" questions were answered by 35 out-of-state extension faculty; and, 42 Nebraska Extension faculty answered 192 out-of-state questions. Nebraska is represented by 587 eXtension members in 55 of the 70 CoPs and 15 who provide leadership for 14 CoPs.

An example of an eXtension initiative led by Nebraska faculty is Beef Cattle and Manure Management. Beef Cattle is a component of a multistate AFRI grant which a number of faculty at the University of Nebraska and US Meat Animal Research Center are OI's. Our faculty also continue to be integral leaders for Animal Agriculture in a Changing Climate, an eXtension initiative that resulted in the development and delivery of a national online course titled Animal Agriculture in a Changing Climate (http://animalagclimatechange.org/free-online-course/). The University Nebraska also has leadership in the Horse eXtension component.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	465101	1387738	151420	325215

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2017
Actual:	15

Patents listed

EXPAND WINDOW TO SEE TABLED LIST

Application DateApplication No. Application Type Status Patent Title

10/17/2016 PCT/US2016/057350 Patent Cooperation Treaty (PCT) Active-PendingFIRE SUPPRESSION AND IGNITION WITH UNMANNED AERIAL VEHICLES

10/26/2016 62/413,054 Provisional Converted USE OF PROBIOTIC BACTERIAL STRAINS AND CELL EXTRACTS TO INHIBIT ACIDOSIS AND LIVER ABSCESSES IN CATTLE

10/31/2016 2947615 PCT National Stage Active-PendingSEC23 NUCLEIC ACID MOLECULES THAT CONFER RESISTANCE TO COLEOPTERAN AND HEMIPTERAN PESTS

11/2/2016 1601006602 PCT National Stage Active-PendingSEC23 NUCLEIC ACID MOLECULES THAT CONFER RESISTANCE TO COLEOPTERAN AND HEMIPTERAN PESTS

11/10/2016 2016144140 PCT National Stage Active-PendingSEC23 NUCLEIC ACID MOLECULES THAT CONFER RESISTANCE TO COLEOPTERAN AND HEMIPTERAN PESTS

11/11/2016 15789290.2 PCT National Stage Active-PendingSEC23 NUCLEIC ACID MOLECULES THAT CONFER RESISTANCE TO COLEOPTERAN AND HEMIPTERAN PESTS

11/17/2016 201580000000 PCT National Stage Active-PendingSEC23 NUCLEIC ACID MOLECULES THAT CONFER RESISTANCE TO COLEOPTERAN AND HEMIPTERAN PESTS

12/19/2016 15/383,332 Utility - Converted Active-PendingPRODUCTION OF ISOPRENE BY METHANE-PRODUCING ARCHAEA

12/30/2016 62/440,845 Provisional Converted Methods of Producing Hybrid-Like Seed Lots

2/1/2017 15/422,409 Utility - Converted Active-PendingMETHOD OF IDENTIFYING IMPORTANT METHYLOME FEATURES AND USE THEREOF

2/1/2017 PCT/US17/16101 Patent Cooperation Treaty (PCT) Active-PendingMETHOD OF IDENTIFYING IMPORTANT METHYLOME FEATURES AND USE THEREOF

3/9/2017 62/469,386 Provisional Active-PendingIDENTIFICATION OF MOLECULAR SIGNALS OF HIGH YIELDING EPIGENETIC PLANTS

8/24/2017 15/685,896 Continuation Active-PendingPROBIOTICS AND METHODS OF OBTAINING SAME

8/28/2017 62/551,100 Provisional Active-PendingMETHODS AND COMPOSITIONS FOR TRACKING INDIVIDUAL ANIMALS IN A GROUP-HOUSED ENVIRONMENT

9/29/2017 62/565,740 Provisional Active-PendingBIOMARKERS FOR RESISTANCE TO PORCINE CIRCOVIRUS 2 ASSOCIATED DISEASE

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	188	287	475

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of Agricultural Research Division HATCH projects in food production/security and

landscapes.

Year	Actual
2017	80

Output #2

Output Measure

- Number of workshops, continuing education programs, Web-based curricula and field days/tours related to food production/security and landscapes.

Year	Actual
2017	877

Output #3

Output Measure

- Number of new extension publications and other education resources related to food production/security and landscapes.

Year	Actual
2017	45

Output #4

Output Measure

- Number of new products and decision tools developed and made available to clientele related to food production/security and landscapes.

Year	Actual
2017	10

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	New knowledge will be generated that will allow Nebraska farmers and ranchers to increase productivity, profitability, and sustainability of food, feed, fuel, or fiber production systems through adoption of research and extension information provided by IANR programs.
2	Nebraska farmers and ranchers will increase their knowledge and awareness of how integrated pest management and pesticide best management practices can help protect water quality and human health while providing acceptable crop pest protection.
3	New knowledge will be generated that will allow Nebraska farmers, ranchers, businesses, and home owners to adopt new practices that will reduce water use, improve water management and protect water quality.

Outcome #1

1. Outcome Measures

New knowledge will be generated that will allow Nebraska farmers and ranchers to increase productivity, profitability, and sustainability of food, feed, fuel, or fiber production systems through adoption of research and extension information provided by IANR programs.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	45000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Agri-business is vital to the state's economy and having a ready and willing workforce has helped those businesses thrive. One of Nebraska's most vital natural resources is its massive supply of groundwater. Nebraska's beef industry generates approximately $7.2 billion in annual cash receipts. The multiplied impact of the $6.5 billion in cattle sales each year is $12.1 billion. The recent downturn in the agriculture economy, low commodity prices, and high input costs, continue to challenge both livestock and row crop producers.

Beef Cattle: Over 41,000 family farms and ranches in Nebraska derive a portion of their income through some aspect of beef cattle production. Fertility in cattle has declined significantly for decades making beef producers less efficient and less sustainable and is estimated to cost approximately $1 billion annually in the US.

Soil Health: Designing efficient, economically sound and environmentally friendly corn-based cropping systems is a prerequisite to remaining competitive. The dilemma facing corn growers and policy makers is the steady increase in corn yield realized with increased nitrogen use. Nitrogen fertilization comes with a steep input cost and a potentially high environmental cost.

What has been done
Programming and products have been developed and presented to help producers navigate these challenging economic times. Nebraska has raised this effort to an Initiative - Strengthening Nebraska's Agriculture Economy - Twitter handle #StrongNebAg. We will continue to program in this area in 2018 as the agriculture economy continues to be challenged.

Beef Cattle: Studies were conducted to investigate the genetic mechanisms that control ovarian follicular development. Another area of study is to optimize reproductive performance of beef cattle with emphasis on heifer development systems and re-breeding after the first calf is born.

Soil Health: Studies were conducted to evaluate the impacts of several cover crops on soil quality in a three-year corn-soybean-wheat organic crop rotation by measuring several soil quality parameters. The impact of grazing corn residue compared with baling corn residue on soil microbial biomass and community structure was examined.

Results

Responses from meeting focused on ag economics:
- 86% were likely to improve management strategies using farm programs, crop insurance, and marketing strategies.
- 85% indicated this program was one of the best attended.
- 410,144 acres managed by participants.
- $2.5 million estimated benefit by producers attending to their operations.

CropWatch.unl.edu and Beef.unl.edu deliver research-based information. Articles on these websites were viewed over 33,000 times and many were reprinted via multiple media formats, multiplying impact.

Beef Cattle: Scientists at UNL identified a population of cows with an excess of androgen in the fluid of the dominant ovarian follicle, a 17% reduction in calving rate, irregular estrous cycles and anovulation. Preliminary data suggest that circulating concentrations of follicle-stimulating hormone (FSH) may be different in these cows compared with the controls. Research with heifer development systems at Nebraska has an estimated savings of $70 per head in the more extensive heifer development systems.

Soil Health: Cattle grazing corn residues appears to have little or no effect on degrading soil properties and no effect on crop yield. While cattle may increase soil compaction, the increase is too small to negatively affect soil properties or crop yield. Cattle grazing of corn residues has the potential to maintain or increase soil fertility and microbial communities. Baling of corn residues resulted in significant losses in soil microbial biomass compared with grazing corn residues. After two years of the crop rotation study, cover crop treatment did not affect soil quality indicators.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
132	Weather and Climate
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

213	Weeds Affecting Plants
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Nebraska farmers and ranchers will increase their knowledge and awareness of how integrated pest management and pesticide best management practices can help protect water quality and human health while providing acceptable crop pest protection.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The High Plains Aquifer, also commonly referred to as the Ogallala Aquifer, stretches through parts of eight states, but its most abundant water resource is located in nearly two-thirds of Nebraska. This groundwater availability has been essential to the success of agriculture in the state. Center pivot irrigation is the most common method of providing water to row crops in the state, and as a result, four of the largest manufacturers of center pivot systems in the world are located in Nebraska.

Nebraska ranks #3 in corn for grain production in the U.S. About 80% of corn grown in the US is genetically modified to include insect resistant genes. The western bean cutworm is a destructive insect pest that can cause severe yield loss in corn and dry beans (up to 40% and 10%, respectively). In addition, farmers and crop consultants have begun to express concern over the performance of insect-resistant transgenic corn and pyrethroid insecticide applications. Given the potential for severe yield reduction as a result of this pest, the loss of current control practices

poses a critical problem for Nebraska farmers. Little data are currently available in the public sector regarding the resistance status of western corn rootworm beetles emerging from genetically modified corn or dry bean fields with higher than expected damage.

What has been done
Program and products were developed that help producers develop strategies and skills to manage agriculture landscapes, agricultural systems, and public lands that will ensure clean water, optimize soil health, and improve the sustainability of Nebraska's natural resource base.

In cooperation with the international community, genomics tools for key corn pests, including assembled and annotated genome and transcriptome sequences, genetic markers, and physical and QTL maps of important traits were developed. These tools were used to characterize races of corn pests. Effects of the seed blend refuge in Bt corn on biology, development, and behavior of multiple lepidopteran pest species was assessed. In addition, IPM and IRM systems for the arthropod complex in corn were developed and assessed.

Results
The 2017 Crop Production Clinics (CPC)
Continued in its nearly 40 year series. CPC connected with over 1,550 people in nine locations across the state.

A new addition to CPC was a two day Crop Management Conference (CMC) featuring more in-depth training. In its inaugural year CMC hosted 336 participants

Over 7 million acres were impacted or influenced by these two programs.

Diagnostic bioassays for documenting susceptibility of western bean cutworm populations to Cry1F and Vip3A proteins were developed. Both toxin overlay on artificial diet and plant lyophilized tissue bioassays were optimized for their use with western bean cutworm. The unique biology of this pest made it impossible to use protocols that worked for other species of Lepidoptera. Bioassays of six populations of western bean cutworm were completed. More than 5,000 western bean cutworm eggs were collected and fed non-Bt, Cry1F, and VIP3a corn tissue in bioassays in which developmental time, head capsule size, and mortality at each stage were documented. Larval mortality was 63% on non-Bt corn; 79% on Cry1F; and 100% on VIP3A. Thus, Cry1F proteins are only killing about 43% of western bean cutworm leaves, which is well below the expected efficacy. In addition, field surveys of natural enemies of the western bean cutworm have also been completed. Four taxa (green lacewings, pink-spotted ladybeetles; convergent ladybeetles, and insidious flower bugs) were identified as the primary candidates for biological control. More than 550 natural enemies were also collected from the field and DNA was extracted for molecular analysis of the gut contents. A species-specific PCR primer was designed and optimized for western bean cutworm. In addition, more than 5 million Trichogramma ostrinae were released onto two commercial fields of dry edible beans (e.g., great northern beans) in Nebraska. Results indicate that Trichogramma were able to disperse a short distance (less than 10 meters) and parasitize western bean cutworm sentinel egg masses within 24 hours of release; however, longer-term persistence in the field was not observed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

133	Pollution Prevention and Mitigation
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
311	Animal Diseases
601	Economics of Agricultural Production and Farm Management

Outcome #3

1. Outcome Measures

New knowledge will be generated that will allow Nebraska farmers, ranchers, businesses, and home owners to adopt new practices that will reduce water use, improve water management and protect water quality.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	45000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our team helps Nebraskans develop strategies and skills to manage water more efficiently in agriculture, communities, and businesses to assure there is water for future generations.

Water is the most limiting factor for agricultural production in the semi-arid environment of central and western Nebraska. While this region sits on top of the High Plains Aquifer, the region receives less than 20 inches of precipitation annually. Crop production systems in the region are highly dependent on irrigation for maximal yields and sustainability. Unprecedented challenges are emerging due to climate change, increased weather variability, increasing demand for freshwater, fiscal constraints, declining aquatic species, and declining water tables and stream flows. Managing water resources has always been challenging due to natural variability, uncertainty in weather patterns and technological advances as well as evolving socioeconomic, policy, and regulations. Thus, there is an urgent need to understand the catalysts that interact with social and ecological conditions to change conservation behaviors, resource management,

and governance.

What has been done
Water Use Efficiency Field Days and Tours. Irrigation timing programs and monitoring of wells and irrigation systems. Programming for well diggers to teach the latest strategies in well digging and avoiding contamination.

Effectiveness of the Nebraska Water Leaders Academy (Academy) in catalyzing change in 20 participants was evaluated by developing and conducting a pre- and post-Academy survey of participants' leadership behaviors. Participants' knowledge of water issues and engagement in water issues was also measured. Additionally, participants were also asked to invite others with whom they have a professional relationship to rate their leadership abilities.

Results
Seventy-eight percent of the participants plan to improve their management based on the knowledge and skills they learned.

On average, participants managed 1,316 acres each, and reported 1.7 inches/acre of potential water savings.

Reported value of knowledge gained at $20,286 per operation.

There was a statistically significant increase in all measured leadership components from pre-Academy to post-Academy. There was also a statistically significant increase in all measured leadership components from pre-Academy to post-Academy from the rater's perspectives. The Nebraska Water Leaders Academy has graduated 101 participants since the program was initiated in 2011. Alumni of the Nebraska Water Leaders Academy have emerged as leaders in their communities and are equipped with the knowledge and skills to drive innovative approaches to water management in Nebraska.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
132	Weather and Climate
133	Pollution Prevention and Mitigation
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

Nebraskans are more resilient and sustainable to climate variation and extreme weather events by adopting best practices and preparing for risks. Nebraska Extension is trusted for science-based information and education that improves climate and extreme weather resiliency.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

More than 5,500 producers, professionals, scientists, youth and, community members were able to enhance their knowledge and use of climate information and resources at more than 90 in-person events to be better equipped to make climate-smart decisions.
Of the in-person attendees survey, 89% (n=258) increased their knowledge and use of climate information to make more informed decisions.
A multistate scenario planning project with South Dakota State University led to multiple interactions with more than 50 cropping systems stakeholders. These discussions yielded over 200 climate-crop scenario impacts and management strategies in order to be more resilient to climate and weather.
Ninety-five percent of survey respondents increased their climate knowledge and awareness of strategies to minimize impact of climate.

Key Items of Evaluation

Nebraska Extension has developed an impact report for each of its Issue Teams. These can be found on our extension impact page at: http://extension.unl.edu/impact/.

The Nebraska Agricultural Experiment Station measures its success in its ability to provide extension with cutting-edge research results that impact Nebraska. In addition, we have begun to use a commercial product (Academic Analytics) to assess faculty productivity measures.
Nebraska Extension continues to identify signature outcomes and indicators in each of its programming areas and is collecting statewide data to assess progress made toward achieving those outcomes. Each year, each extension Issue Team completes an impact report highlighting its efforts and the impact of those efforts on clientele. These are available at: http://extension.unl.edu/impact/. These reports have been instrumental in working with stakeholders, who in turn used them to advocate on behalf of the extension program. Additional efforts are underway to enhance the skills of Issue Team leaders to strengthen selected indicators and evaluation strategies.

Information regarding Academic Analytics can be found at: http://www.academicanalytics.com/.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

People and Their Well-being

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		21%	
204	Plant Product Quality and Utility (Preharvest)	0%		6%	
303	Genetic Improvement of Animals	0%		1%	
308	Improved Animal Products (Before Harvest)	0%		1%	
403	Waste Disposal, Recycling, and Reuse	0%		5%	
501	New and Improved Food Processing Technologies	0%		4%	
502	New and Improved Food Products	0%		9%	
503	Quality Maintenance in Storing and Marketing Food Products	0%		4%	
607	Consumer Economics	0%		2%	
608	Community Resource Planning and Development	15%		1%	
610	Domestic Policy Analysis	0%		5%	
702	Requirements and Function of Nutrients and Other Food Components	0%		13%	
703	Nutrition Education and Behavior	20%		1%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	0%		1%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		4%	
724	Healthy Lifestyle	15%		5%	
802	Human Development and Family Well-Being	0%		12%	
806	Youth Development	50%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	76.0	0.0	11.0	0.0
Actual Paid	88.7	0.0	21.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1877691	0	750953	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
2139925	0	509978	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Basic and applied research will focus on rural and urban family life and lifestyles; human nutrition, with particular emphasis on how foods, our molecular and macro-environments, and food systems interact to impact our well-being; and food sciences, including food processing safety, food production waste reduction, and processing technologies to ensure human well-being and nutritious food choices.

Planned program activities include a cascaded approach to creating long-term behavior change. Each program area will include mass-media educational efforts (websites, news articles, general contacts) to reach the general public; 1-2 hour workshops that focus on increasing knowledge; longer-term (4-6 hour) learning experiences that begin to change attitudes and practices; and in-depth training designed to create behavior change that involves multiple contact opportunities over an extended period. By using this approach, a variety of learners is engaged in programming that best fits their needs.

Examples of program activities include:

- Workshops for child care providers to increase their skills in developing social-emotional strengths in young children.
- Web-based learning modules designed to give divorced or separated parents the skills to better interact with their families.
- Campus-based career camps that enable high school students to interact with faculty while exploring post-secondary options.
- Nutrition education workshops to help high risk families make healthy choices on limited budgets.
- Technology-based experiences (using apps, social media, etc.) to help engage users in learning around core topics.
- Workshops for food service providers and post-harvest producers on cutting-edge resources to

enhance food safety and quality.

All of these program activities will be purposefully designed to reach targeted outcomes and achieve long-term impact.

2. Brief description of the target audience

The target audience includes:

- High-risk families
- Children and youth
- Families of young children (young children defined as those 0-8)
- Producers
- Good processing and retail establishment owners/workers
- Consumers
- Business and community leaders

3. How was eXtension used?

All of our faculty are asked to apply for an eXtension email and become a member. eXtension continues to serve as a valuable resource for clients and faculty. For subject areas outside of our focused areas of work, it provides a primary web resource used by faculty and clientele for land-grant university information. For example, eXtension is our primary land-grant web resource for subject areas such as farm safety, freshwater aquaculture, goats, and grapes, all topic areas for which Nebraska Extension provides little or no web content. In addition, Nebraska Extension websites link to eXtension, and eXtension serves as a resource for faculty in answering questions and providing supplemental resources for face-to-face training sessions. Nebraska Extension faculty also use the training and resources of eXtension to expand their skills and expertise in efforts to better serve clientele.

In 2017, Nebraska citizens using "Ask an Expert" asked 245 questions with 160responses provided by 64 Nebraska Extension faculty; 94 "Ask an Expert" questions were answered by 35 out-of-state extension faculty; and, 42 Nebraska Extension faculty answered 192 out-of-state questions. Nebraska is represented by 587 eXtension members in 55 of the 68 CoPs and 15 who provide leadership for 14 CoPs.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	481010	1593930	272161	448522

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2017
Actual:	6

Patents listed

EXPAND WINDOW TO SEE TABLED LIST

Application Date Application No. Application Type Status Patent Title

10/3/2016 15/284,336 Continuation Active-Pending EFFECTIVE HAIR STYLING COMPOSITIONS AND PROCESSES

12/21/2016 15/386,257 Utility - Converted Active-Pending Compression Molded Composites from Unshredded Carpets

1/14/2017 62/446,434 Provisional Converted MITOCHONDRIAL PROTEASE OMA1 AS A MARKER FOR BREAST CANCER

1/20/2017 62/448,544 Provisional Converted Nanoporous Starch Aerogels Impregnated With Phytosterols And Methods Of Preparing The Nanoporous Starch Aerogels

3/15/2017 62/471,572 Provisional Active-Pending EXTRACELLULAR VESICLES AND METHODS OF USING

9/5/2017 15/555,873 PCT National Stage Active-Pending NON-NEUROINVASIVE VIRUSES AND USES THEREOF

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	159	61	220

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of extension in-depth workshops.

Year	Actual
2017	146

Output #2

Output Measure

- Percentage of Agricultural Research Division HATCH projects in nutrition, family health and well-being, food safety, and career development.

Year	Actual
2017	20

Output #3

Output Measure

- Number of scholarly publications and curricula related to nutritional sciences and family well-

being.

Year	Actual
2017	10

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	New knowledge will be generated that will allow increased adoption of preharvest methods for food quality and safety.
2	Nebraska will have access to a more highly educated workforce to meet the needs of the 21st century workplace.
3	Youth will increase behaviors that result in healthier lifestyles.

Outcome #1

1. Outcome Measures

New knowledge will be generated that will allow increased adoption of preharvest methods for food quality and safety.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4582

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Beef Cattle: Nebraska is known domestically and internationally for producing high quality beef, which is an important sector of the Nebraska economy. With the growth of ethanol from the corn industry, distillers grains have become an important component of cattle diets. With the inclusion of distillers grains in cattle diets, increases in polyunsaturated fatty acids (PUFA) content and decreased oxidative stability and retail display shelf life have been reported.

The safety of beef products is essential. To provide a safe product and reduce risks, antimicrobial interventions are applied to beef products but may also impact product quality and shelf life. Sous vide cooking is a technique of cooking vacuum packaged food items at a low, constant temperature for an extended period of time for quality and to ensure control of pathogens. Shortened cooking times by a home cook could provide a food safety risk.

Engineering for Food Quality and Safety: The increased prevalence of diet-related illnesses (e.g., obesity, cardiovascular disease, cancer) and the emerging trend of "green" consumerism have negatively impacted the acceptability of foods containing artificial ingredients and have led the food industry to prioritize development of foods and beverages containing bioactives such as phytosterols, tocopherols, carotenoids, omega-3, and essential oils to improve food quality and safety. However, incorporation of lipophilic bioactives into foods is challenging because it is not easy to add them to water-based foods; insolubility in water leads to low bioavailability; and they degrade easily during storage. Thus, effectively including lipophilic bioactives in foods and beverages is a major challenge and there is a critical need for simple and clean methods to incorporate water-insoluble bioactives into foods and beverages.

What has been done

Beef Cattle: The impact of feeding several forms of de-oiled corn distillers grains and the effect of supplementing OmniGen-AF as an antioxidant to extended beef shelf life were studied.

Effects of E.coli interventions on product quality have been studied. Organic acids (lactic acid, BeefXideTM , and peroxyacetic acid) using different application methods (dip, spray, and electrostatic spray) were evaluated on beef clods for their ability to reduce amounts of E. coli.

Application of high pressure processing can provide E. coli control prior to sous vide cooking; however, changes in color and tenderness can impact palatability. High pressure processing (450 MPa for 15 minutes or 600 MPa for 10 minutes) was applied to steaks intended for sous vide cooking to control E. coli.

Engineering for Food Quality and Safety: Nanoporous aerogels from wheat starch using supercritical carbon dioxide drying of the starch alcogels formed from gelatinized starch was developed. Temperature was used as a crosslinker to gelatinize the starch, which eliminated chemical crosslinkers from the process. The melting behavior and volumetric expansion of various solid lipids (monoacylglycerols, diacylglycerols, triacylglycerols, and their mixtures) in pressurized carbon dioxide were evaluated. A novel method was used to determine the melting point of lipids in pressured gases. This information was used for the formulation of the solid lipid matrix that was used to develop antimicrobial hollow solid lipid micro and nanoparticles using innovative technology based on supercritical fluid technology. This is the first study determining the melting behavior of a complex lipid mixture in pressurized carbon dioxide. In addition, a molten solid lipid was pressurized with supercritical carbon dioxide to form a carbon dioxide-expanded lipid. This carbon dioxide-expanded lipid was depressurized through a nozzle and upon depressurization, hollow solid lipid particles formed due to a sudden natural cooling that occurs naturally in this system. The temperature, pressure, and nozzle diameter were optimized to form intact hollow solid lipid particles.

Results

Beef Cattle: Including de-oiled wet distillers grains (65%, DM basis) plus solubles (WDGS) increased polyunsaturated fatty acids similar to the levels obtained with full-fat WDGS. Lower including levels of de-oiled wet distillers grains (35 or 50%, DM basis), generated beef with intermediate levels of polyunsaturated fatty acids. Steaks from cattle on the 50% de-oiled dry distillers grains and solubles diet had lower color and lipid stability in retail display times than steaks from cattle on the corn (control) diet. Thus, the de-oiling process did not alleviate challenges from feeding corn distillers grains. Addition of antioxidants may be beneficial to off-set any potential detrimental effects of distillers grains on beef shelf life. OmniGen-AF (a potential antioxidant) supplementation did not alter color, lipid stability, or superoxide dismutase activity. In addition, changes in tenderness between quality grades cannot be explained by the changes in superoxide dismutase.

All three organic acids/blends (lactic acid, BeefXideTM, and peroxyacetic acid) reduced E. coli using the dip or spray application method. These antimicrobial interventions had minimal impact on the quality of ground beef.

High pressure processing provided greater than a 5.0 log CFU/g reduction of E. coli and essentially eliminated the risk of E. coli O157:H7 and STEC contamination. The high pressure processing also resulted in lighter colored, less red steaks after sous vide cooking. These steaks were also tougher and received lower acceptability ratings in taste panels. The lower pressure high pressure processing treatment could provide a base for providing a safe product with the least reduction in product acceptability by consumers.

Engineering for Food Quality and Safety: Novel nanoporous starch aerogels made from inexpensive starch sources (e.g., corn) were developed and used to enhance the bioavailability of water-insoluble bioactives in water to prepare health-improving foods and beverages in a simple and clean way. Novel carrier systems from solid lipids and proteins using novel nanoparticle formation methods to develop natural antimicrobials using essential oils were also developed. Lipids are promising delivery vehicles for lipophilic bioactives due to their biocompatibility and enhanced absorption. A simple and green method to form hollow solid lipid micro- and nanospheres that can be loaded with lipophilic bioactives was used to form essential oil-loaded hollow solid lipid micro and nanoparticles. Hollow solid lipid micro- and nanospheres have higher loading capacity and minimized bioactive expelling due to hollow structure compared with the conventional solid lipid nanoparticles. In addition, hollow solid lipid micro- and nanoparticles were used to develop natural antimicrobial delivery systems using essential oils because the solid lipid shell prevents evaporation of essential oils, provides controlled release, and prevents quick creaming or settling in water. These processes do not use solvents or toxic chemicals. In addition, energy consumption during processing was decreased and lower temperatures did not degrade the heat sensitive bioactives during processing.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
204	Plant Product Quality and Utility (Preharvest)
308	Improved Animal Products (Before Harvest)
608	Community Resource Planning and Development
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Nebraska will have access to a more highly educated workforce to meet the needs of the 21st century workplace.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	62945

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Empowering Nebraska youth to make decisions about their future remained the primary focus of all College & Career Success programs in 2017. Although programming was offered to youth in grades 5 through 12, the largest reach was found with high school youth. Overall, more than 10,000 youth from across Nebraska were impacted through a variety of college and career success programming efforts.

What has been done
Through the delivery of the Connect the Dots program, the College and Career Success Team was well positioned to provide a unique and strategic method of engaging its learners. In this program, students experience a "real-life" simulation through hands on activities, to learn how their high school choices impact their post-secondary and workplace experiences. This simulation involves multiple rounds of face-to-face interaction with employers from their local communities, as well as representatives from universities, colleges, and the military.

In addition to the methods used in the Connect the Dots program, many other youth are also engaged through programs delivered in their schools or communities and through on-campus experiences. A common thread found throughout many of the college and career success programs is connecting a young person with an employer from the community who can share real life knowledge and experiences.

Next Chapter at Nebraska is a college readiness program and a UNL pre-admittance program offered to 8th grade students enrolled in 4-H. Following the pre-admittance and throughout high school, students engage in events, activities and curriculum where they learn how to successfully transition from high school to college. This unique program meshes college and career readiness programming with traditional 4-H programs and activities. Partnerships are forming with schools statewide, Nebraska Extension, 4-H and the University of Nebraska-Lincoln Office of Admissions.

Participants in Youth Entrepreneurship and Business Opportunities (YEBO) programs have been shown to embrace an entrepreneurial mindset and gain skills to create new businesses, which ultimately contribute to the economic vitality of Nebraska communities and beyond.

Results
CONNECTING THE DOTS
This career exploration program, which was hosted 19 times throughout Nebraska, reached a total of 1,698 freshmen and sophomore students. The success of the program was evidenced through the addition of eight new programs in 2017. More than 250 community partners participated, an increase of 110 partners from 2016. Through participation in this daylong experience, youth are enabled to make informed decisions about college and career aspirations that are personally meaningful. Additionally, youth learn professional communication appropriate to the academic and workplace context. After participating in the Connecting the Dots program:
- 96% understand their post-secondary opportunities in Nebraska, a growth of 20%
- 83% narrowed down their career options, an increase of 33% from when youth began the program
- 91% have thought about how to pay for college
- 81% learned how to act professionally
- 77% say 4-H has helped them identify things they are good at and explore their future career options

NEXT CHAPTER AT NEBRASKA
- 1,768 4-H members were pre-admitted to NEBRASKA through Next Chapter
- 197 people participated in the Next Chapter district and statewide celebrations
- 456 youth are participating in Chapter 1 of the program during the 2017-2018 school year

SOLAR ECLIPSE
On August 21, 2017, over 200 Nebraska communities fell within the path of totality of the solar eclipse. Nebraska Extension and Raising Nebraska partnered with the Hastings Museum to offer solar eclipse trainings for teachers and youth professionals in advance of the total solar eclipse.
- 168 teachers, librarians and Extension staff taught the curriculum to almost 1,000 youth in multiple states.
- 199 temperature readings were recorded on an interactive map for a citizen scientist project.
- 71% of youth participants learned new concepts about science through the eclipse materials.
- 70% of youth participants stated they are interested in a STEM career.

SUMMER READING CONNECTION
Over 1,600 elementary and junior high youth from 14 counties participated in the Summer Readings Connection program taught by extension staff, librarians, and volunteers in libraries around the state. Throughout the program, youth were given opportunities to gain confidence in STEM as they explored different concepts and engineered solutions. Following the program, 79% of the youth surveyed stated that enjoyed doing STEM activities outside of school and 78% stated they would like to have a job related to STEM.

INVENTURE Day
During INVENTURE Day, students familiarize themselves with local businesses and business owners and identify potential entrepreneurial careers. Using innovation and creation, youth form teams to develop a unique business around a given product.
- 946 youth participated in INVENTURE Day
- 1,503 youth participated in entrepreneurial curriculum
- More than 100 mentors, volunteers and businesses supported YEBO activities
- 18 INVENTURE Day programs were implemented.
- 85% of participants increased their knowledge of what it takes to start a business; a 58% increase. n=515
- 83% of participants know what is means to be an entrepreneur; a 45%increase. n=515
- 82% of youth learned skills that will help them be successful if they decide to start their own business; a 41% increase. n=435

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
724	Healthy Lifestyle
802	Human Development and Family Well-Being
806	Youth Development

Outcome #3

1. Outcome Measures

Youth will increase behaviors that result in healthier lifestyles.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	90939

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nebraska ranks 13 in the United Health Foundation's America's Health Ranking for 2017. Obesity increased 13% from 28.4% to 32% of adults. The state ranks 24th for senior health and 17th for the health of women and children. This has a negative impact on Nebraska's economy because of missed work and higher health care costs. In addition, because parents are often the food providers in the home, negative food behavior of adults leads to negative behavior in children and a more serious obesity spiral.

Despite these sobering statistics, changes are occurring. In the past year:
- children in poverty decreased 1% from 15% to 14%.
- immunizations among children 19 to 35 months old increased 80.6%.
- the percentage of the population without health insurance decreased to 8.4%.
- preventable hospitalizations increased 2% from 46% to 48% discharges per 1,000 Medicare enrollees.
- premature death increased 7% from 6,125 to 6,529 years lost per 100,000 population.
- in the past five years, smoking decreased 15% from 20% to 17% of adults.

What has been done
Nebraska Extension helps children and youth improve eating and physical activity patterns with direct education and healthier home, school, and community environments. By supporting healthy behaviors and environments, we help reduce food and health care costs by helping prevent chronic health conditions.

Nebraska Extension focuses on delivering research-, evidence-, and practice-based nutrition education and physical activity programs and environmental strategies. Our programs impact

individuals and families where they eat, live, work, learn, shop, and play. Delivery methods include direct education, indirect activities, and policy, system, and environment (PSE) initiatives. Examples include: group education, field days, health fairs, train-the-trainer workshops, website, social media, newsletters, and radio.

Internal and external funds reinforce our programming. Example funding sources include: USDA (including SNAP-Ed, EFNEP, and Team Nutrition), Department of Health and Human Services (DHHS), Nebraska Department of Education (NDE), National 4-H Council, Nebraska Extension, and NU Foundation. Over $1.9 million in grant funds helped support our programs.

To strengthen our programs, we collaborate with federal agencies, non-profit organizations, foundations, associations, other universities, and community coalitions and councils.

Our goals are to increase consumption of healthy foods and beverages, engage in healthy levels of physical activity, and make the healthy choice the more desirable choice. Core programs included: CATCH Kids Club, Kids in the Kitchen, School Enrichment Kits, Choose Health: Food, Fun, and Fitness, Go NAP SACC, School Wellness, and Slim by Design.

Results

Supplemental Nutrition Assistance Program (SNAP-Ed), Expanded Food and Nutrition Education Program (EFNEP), and Team Nutrition (School-age focus). Comprehensive strategies and interventions were carried out by 48 staff across Nebraska, reaching 12,156 adults and 19,112 youth for SNAP-Ed, and 1,156 adults and 2,077 (1,369 graduates) youth in EFNEP, which improved the graduation rate for EFNEP to 52%.

Food Resource Management Practices:
- 79% (473 of 595) of participants showed improvement in one or more food resource management practices (e.g. plans meals, compare prices, does not run out of food, or uses grocery lists).

Nutrition Practices:
- 86% (511 of 595) of participants showed improvement in one or more nutrition practices (e.g. plans meals, makes healthy food choices, prepares food without adding salt, reads nutrition labels or has children eat breakfast).

Food Safety Practices:
- 62% (366 of 593) of participants showed improvement in one or more food safety practices (e.g. thawing and storing foods correctly).

Youth: 1369 graduates. Diet Quality:
- 77% (1018 of 1321) of children and youth improved their abilities to choose foods according to Federal Dietary Recommendations or gained knowledge.

Physical Activity:
- 37% (476 of 1294) of children and youth improved their physical activity practices or gained knowledge.

Food Safety:
- 45% (589 of 1317) of children and youth used safe food handling practices more often or gained knowledge.

Food Resource Management:
- 58% (90 of 155) of children and youth improved their ability to prepare simple, nutritious, affordable food or gained knowledge

Food Security:
- 17% (8 of 46) of youth acquired skills to be food secure or gained knowledge.

CATCH Kids Club (CKC)

A new physical activity (PA) and nutrition education program was implemented: $22,983 from state funds, SNAP-Ed, and other grants were used to purchase curriculum and physical activity kits and provide two implementation trainings (n=39) and one PA training (n=21) for staff. To ensure long-term sustainability, four staff attained CATCH Trainer Certification to conduct implementation trainings.
- Over 5,000 youth (86% white, 14% miniority, 32% Hispanic or Latino)
- 75% were physically active most days
- 88% agreed being active is good for them
- 86% agreed physical activity will help them stay fit

FOOD.UNL.EDU is the third most visited website at the University of Nebraska with 2.8 million+ page views in 232 countries in 2017. It is a nationally known resource for those wanting information on food, nutrition, health and food safety. Top search items include: Cook It Quick tips, Food Reflections GMO article, What's on the Label?, and Preventing Food Waste.

Nebraska Extension Team Nutrition (NE TN) completed the build-out of the School Enrichment Kits (SEK) for state-wide and Lincoln Public Schools use for the 2017-18 school year. Ninety-two kits were built to assist with school health programming for grades K-5; 2,350 4th and 5th grade students will now receive yearly nutrition education programming with the kits built; 3,200 3rd grade students yearly will now be receiving nutrition education programming; 250 kindergarten, 1st and 2nd grade students yearly will be receiving nutrition education programming with the kits built. In total, 5,800 students will now have access to health programming that they did not before this year, and all 18,000 elementary students in the Lincoln Public Schools district will have access to the School Enrichment Kits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
703	Nutrition Education and Behavior
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
724	Healthy Lifestyle
802	Human Development and Family Well-Being
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

Research and extension have been able to successfully meet goals as planned in the area of people and their well-being. Nebraska Extension continues to be cognizant of over-arching issues such as feeding 9 billion people, global water supplies, and how those will impact our work related to educating Nebraskans on healthier lifestyles and creating a well-educated workforce.

Research and extension faculty continue to be watchful for emerging issues and world conditions that could change food systems and the global trust that consumers have of U.S. agriculture. In addition, Nebraska faculty are at the forefront of basic research in food allergies, food safety through the food chain, and microbiome profiling.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Nebraska Extension has developed an impact report for each of its Issue Teams. These can be found on our extension impact page at: http://extension.unl.edu/impact/.

The Nebraska Agricultural Experiment Station measures its success in its ability to provide extension with cutting-edge research results that impact Nebraska. In addition, we have begun to use a commercial product (Academic Analytics) to assess faculty productivity measures.

Key Items of Evaluation

Nebraska Extension continues to identify signature outcomes and indicators in each of its programming areas and is collecting statewide data to assess progress made toward achieving those outcomes. Each year, each extension Issue Team completes an impact report highlighting its efforts and the impact of those efforts on clientele. These are available at: http://extension.unl.edu/impact/. These reports have been instrumental in working with stakeholders, who in turn used them to advocate on behalf of the extension program. Additional efforts are underway to enhance the skills of Issue Team leaders to strengthen selected indicators and evaluation strategies.

Information regarding Academic Analytics can be found at: http://www.academicanalytics.com/.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.