2015 University of Nebraska Combined Research and Extension Annual Report of Accomplishments and Results

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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 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 Nebraska residents. Within the past three years, this strategic two-way dialogue moved to a new, higher plane as "Vision for 2025" was rolled out. This visioning process was created because of the need to: determine how IANR will contribute to the critical need to double the world's food supply to feed 9 billion people; address 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 three jobs is directly tied to agriculture or agribusiness, and the state strives to increase job opportunities. As a result of the visioning process, the priorities of IANR became food, fuel, water, landscapes and people. Entrepreneurship is a cross-cutting thread of these five issue areas.

"Vision for 2025" engaged key Nebraska government leaders, stakeholders, representatives of organizations, faculty, and students/youth. The process began with community listening sessions throughout Nebraska, discussions among faculty/administrative leaders, representatives of civic and community organizations and the agricultural industry; focus group discussions about specific topics such as the future of rural communities; and teams of faculty writing planning documents that were discussed at round-table discussions throughout the year. An underlying principle throughout the process was public input/dialogue. Long-term goals of IANR administrative units that support these priorities of food, fuel, water, landscapes, and people can be found at: http://go.unl.edu/t49a and the progress report at: http://go.unl.edu/woom.

These priority outcomes of food, fuel, water, landscapes, and people are representative of the societal challenge areas of NIFA. For example, in the Nebraska planning process "food" represents the continuum of farm to fork, which includes the basic life sciences, production, food security and hunger, childhood obesity, nutrition, and food safety. "Landscapes" represents the productivity and sustainability of climate, water, soil, and all of our natural resources. "People" represents the well-being of children, youth, and families as they interact with their environments.

The Institute of Agriculture and Natural Resources strives to meet the needs of its Nebraska citizens through engagement in internationally-recognized science and education. This mission is 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 non-formal learning strategies. The ongoing cultivation of public-private partnerships helps make this mission more achievable.

The importance of integrating missions is most evident in the upward trajectory of grant/contract dollars received, the rigor of educational programs delivered in both formal and non-formal settings, and in the

placement of graduates in their careers.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	228.0	0.0	140.0	0.0
Actual	231.6	0.0	136.4	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

During 2015 multiple approaches were used to engage both internal and external audiences of research and extension in the review of programmatic goals. External advocacy groups with broad statewide membership, such as Agriculture Builders of Nebraska and Family, Youth, and Community Partners, reviewed the strategic objectives that address food, fuel, water, landscapes, and people. These groups provided feedback and suggestions for the long-term goals. Each external advocacy group met at least three times during the year.

Research and extension continued their annual review of extension plans of work and Hatch projects. Faculty teams are in place for each of the extension action plans (Beef Systems; The Learning Child; Community Environment; Community Vitality Initiative; Cropping & Water Systems; Food, Nutrition & Health; and 4-H Youth Development). Teams are composed of educators and specialists working in each content area. Based upon the issues impacting the state and region, teams developed, delivered, and assessed the educational programs delivered. Additionally, each of the teams interacted with external stakeholders. These are stakeholders who are intimately involved in the subject matter areas included in the content area of that action team; for example, action team members associated with food-nutrition-health met one-on-one and in small groups with industry representatives, dietitians, staff of the Nebraska Department of Agriculture and Department of Health and Human Services. Faculty members of the Agricultural Research Division had their Hatch projects reviewed by a team of faculty and administrators as the projects came up for review. Significant programmatic funding was provided to multi-state Hatch projects after each was reviewed by both internal and external peers. State commodity check-off boards provided input as they assessed over 100 research and extension proposals. In Nebraska, many IANR tenured faculty have joint research/extension appointments; hence, their research and extension work is seamless.

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.

Extension developed public value statements used by stakeholders to 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 action plan (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.

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.
In 2010, extension added a staff member to identify and encourage private/public partner engagement in developing educational endeavors; this has yielded working relationships with the transportation industry, and with companies seeking to work with local communities, plant sciences, and telecommunications. The Agricultural Research Division has multiple advisory committees that speak to the long-term goals for bench and translational science.

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 UNL Extension Directions Group consisting of seven extension faculty from each of the major seven 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 issues 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 UNL 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.

In 2015, UNL Extension partnered 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 keep 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, 11 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
5104690	0	4339618	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	4787961	0	4413583	0
Actual Matching	5104690	0	4404450	0
Actual All Other	0	0	0	0
Total Actual Expended	9892651	0	8818033	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	891496	0	1563104	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	10%		9%	
111	Conservation and Efficient Use of Water	8%		9%	
112	Watershed Protection and Management	4%		5%	
132	Weather and Climate	3%		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	20%		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	3%		3%	
302	Nutrient Utilization in Animals	2%		6%	
305	Animal Physiological Processes	0%		5%	
307	Animal Management Systems	20%		3%	
311	Animal Diseases	3%		5%	
601	Economics of Agricultural Production and Farm Management	7%		1%	
605	Natural Resource and Environmental Economics	2%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	152.0	0.0	129.0	0.0
Actual Paid	138.7	0.0	116.3	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**
3023445	0	3652667	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2899844	0	3865949	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?

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 dairy, farm safety, freshwater aquaculture, goats, and grapes, all topic areas for which UNL Extension provides little or no Web content. In addition, UNL 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. UNL Extension faculty also use the training and resources of eXtension to expand their skills and expertise in efforts to better serve clientele.

In 2015, Nebraska citizens using "Ask an Expert" asked 216 questions with 142 responses provided by 79 UNL Extension faculty and 72 "Ask an Expert" questions were answered by 31 out-of-state extension faculty, with 40 UNL Extension faculty answering 134 out-of-state questions. Nebraska is represented by 585 eXtension members in 55 of the 68 CoPs and 17 who provide leadership for 14 CoPs.
Examples of eXtension initiatives led by Nebraska faculty include: 1) Animal Agriculture in a Changing Climate is 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/). A national team of land-grant university experts was assembled for authoring and pilot testing of the course. 2) In addition, two eXtension communities of practice, Livestock and Poultry Environmental Learning Center and Animal Agriculture in a Changing Climate, cooperated to host the second Livestock Waste to Worth National Conference (held March 31, 2015, in Seattle).

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	446882	1787528	103865	415460

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

Patent Applications Submitted

Year:	2015
Actual:	31

Patents listed

Patent TitleFiling DateApplication No.Application TypeStatus
METHODS AND COMPOSITIONS FOR OBTAINING USEFUL PLANT TRAITS9/24/2014EP14186459.5 EPO - European Patent OfficeActive - Pending
Genetic markers for susceptibility to Porcine Circovirus 2 Associated Disease9/26/201462/056,416PRV - ProvisionalActive - Pending
METHODS AND COMPOSITIONS FOR OBTAINING USEFUL PLANT TRAITS9/24/201414/495,498119 - US from PRV or PCT Foreign PriorActive - Pending
Improved Epigenetic Lines8/25/201462/041,227PRV - ProvisionalConverted
Methods and Compositions for Obtaining Useful Plant Traits8/7/201414/454,518119 - US from PRV or PCT Foreign PriorActive - Pending
Method for the production of a high saturate, low polyunsaturated soybean oil8/1/201462/032,273PRV - ProvisionalActive - Pending
SEC23 NUCLEIC ACID MOLECULES THAT CONFER RESISTANCE TO COLEOPTERAN AND HEMIPTERAN PESTS5/6/201461/989,170PRV - ProvisionalActive - Pending
Plants with improved traits5/14/201461/992,945PRV - ProvisionalActive - Pending
CHEMICAL METHODS FOR OBTAINING USEFUL PLANT TRAITS5/1/201461/987,084PRV - Provisional Active - Pending
Methods and Compositions for Obtaining Useful Composite Plants4/24/201461/983,520PRV - Provisional Active - Pending
Improvement in renewable methane yield from anaerobic digestion4/17/201461/980,656PRV - Provisional Active - Pending
Improved Method for Epigenetics4/16/201461/980,096PRV - ProvisionalActive - Pending
Method of Breeding the Epigenome3/26/201461/970,424PRV - ProvisionalConverted
A method for development of a porcine reproductive and respiratory virus vaccine strain capable of inducing broad protection3/21/201461/968,465PRV - ProvisionalActive - Pending
Improved Epigenetic Lines1/23/201461/930,602PRV - ProvisionalConverted
Drought adaptive root gene in wheat - I & II2/13/201461/939,329PRV - ProvisionalConverted
Plants With Useful Traits and Related Methods3/18/20142014-509380FOR - ForeignActive - Pending
Plants With Useful Traits and Related Methods12/26/2013201280031753.8 FOR - ForeignActive - Pending
Plants With Useful Traits and Related Methods10/31/201314/114,945FOR - ForeignActive - Pending
A method for improved plant inbred lines11/7/201361/901,349PRV - ProvisionalConverted
Movable Center Pivot Fence for Cattle11/5/201314/071,761119 - US from PRV or PCT Foreign PriorActive - Pending
Altering Plant Biomass by Misregulation of Sphingolipid Homeostasis10/7/201361/887,635PRV - ProvisionalExpired

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	74	258	332

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
2015	84

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
2015	922

Output #3

Output Measure

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

Year	Actual
2015	47

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
2015	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Nebraska farmers and ranchers will increase productivity and profitability through adoption of research and extension information provided by IANR programs (measured by value placed on the information by clientele)
2	Nebraska farmers and ranchers will have sustainable food and biomass systems through adoption of best management practices (measured by percent of clientele adopting best management practices).
3	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 (measured by the number of farmers and commercial applicators certified in pesticide safety).
4	Nebraska ranchers will increase sustainability of range resources through adoption of research and extension information provided by IANR programs (measured by value placed on the information by clientele).
5	Consumptive water use by irrigated crops will be reduced. The outcome measure will be the percent reduction of estimated consumptive water use when the current year is compared to the estimated consumptive water use in calendar year 2006. The consumptive water use will be estimated using the irrigation water pumped in Natural Resource Districts that require the use of water measurement devices.
6	Nebraska farmers, ranchers, businesses and home owners will adopt new practices that will improve water management and protect water quality. This will be measured as the percentage of education program participants who indicate they have adopted or plan to adopt new practices.

Outcome #1

1. Outcome Measures

Nebraska farmers and ranchers will increase productivity and profitability through adoption of research and extension information provided by IANR programs (measured by value placed on the information by clientele)

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	167240000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nebraska ranks #4 in the US in total livestock receipts and livestock products account for about 2/3 of Nebraska's farm income. Infectious diseases in livestock are widespread and cause significant economic losses to producers. Current vaccines do not provide sufficient levels of protection against many viruses. Porcine reproductive and respiratory syndrome (PRRS) causes about $664 million in losses to American swine producers annually by causing reproductive failure in pregnant sows and respiratory diseases in young pigs. Porcine circovirus type 2 (PCV2) is the etiological agent of a group of associated diseases (PCVAD) that negatively impact production efficiency and can lead to mortality. A common practice is to vaccinate all pigs, which increases production costs, even though only 10-15% of the naturally infected pigs express the disease. Research to improve the health of pigs will have an important, positive economic impact on the Nebraska economy.

Cereal Grains: Winter small grains are important crops in Nebraska and are needed to provide growers and consumers with the necessary food and feed crops to ensure global food security. Winter wheat was planted on more than 600,000 hectares in Nebraska in 2012, and cultivars developed by UNL scientists were grown on 50-80% of these acres. Wheat cultivars that increase the state yield by one bushel per acre would increase farm revenue by $13 million. Winter triticale is an emerging crop that is being planted on more acres while winter barley has the smallest potential market, but is the most drought tolerant crop of these three cereals.

What has been done
PRRS Vaccine: UNL scientists combined computational and molecular methods to generate a de novo synthesized PRRS strain based on an artificial genome sequence for PRRS. Others have used this approach to generate vaccine immunogens to individual proteins; however, work at UNL

expanded this concept to create a synthetic PRRS strain based on a centralized, entire PRRS genome sequence.

PCV2 Genetic Resistance: Previous research by UNL faculty identified DNA polymorphisms in two genomic regions, including the Swine Leukocyte Antigen II (SLAII), which explained differences in viral load, immune response, and growth. Studies conducted at UNL were designed to validate the effect of these polymorphisms in experimental and natural challenges with PCV2 and to investigate the interaction between host genetics and immunosuppressive roles of PCV2 in secondary challenges. In 2015, additional studies were conducted to identify the functional genes and polymorphisms associated with these effects.

Cereal Grains: Studies were conducted to develop new winter small grain cultivars with improved performance and stability over diverse environments and in response to biotic (e.g., diseases and insects) and abiotic stress (e.g., temperature and drought); develop new germplasm (e.g., transgenic and hybrid wheat), and improve breeding methods. Scientists at UNL are the only developers of winter barley cultivars and along with scientists at Texas A&M are the only two public winter triticale breeders in the Great Plains.

Results

PRRS Vaccine: The PRRS consensus genome is fully infectious and displays characteristics typical of a naturally occurring PRRS strain in vitro and in vivo. When inoculated into pigs, this synthetic PRRS strain conferred significantly broader levels of heterologous protection against divergent PRRS viral strains compared with a reference wild-type PRRS strain. The synthetic PRRS strain was also considered to be an excellent candidate for development of a broadly protective PRRS vaccine. This is the first report of centralizing the entire genome of an RNA virus to improve vaccine coverage. This research was awarded the 'Breakthrough Innovation of the Year award in 2015 by NUtech Ventures (Unl's intellectual property and commercialization unit). In addition, an invention patent was filed by NUtech Ventures on behalf of the three UNL faculty members that conducted this research.

PCV2 Genetic Resistance: Using genome-wide association analyses, UNL scientists uncovered two DNA markers that influenced susceptibility to PCVAD and explained 15% of the genetic variation of viral load. Among infected pigs, the pigs that carried favorable alleles from the two identified DNA markers had lower viral load and weekly viremia as well as higher overall and weekly weight gains. Detailed characterization of the QTL region uncovered a putative gene that has a role in innate immune responses. The DNA markers that were identified by these UNL scientists have an effect across different genetic lines of pigs, predict susceptible pigs, and as a result could have positive impacts on economics for producers and animal welfare in the swine industry.

Cereal Grains: In 2015, UNL released the new hard red winter wheat cultivar (NE10589), two winter barley cultivars, and two winter triticale cultivars. The NE10589 wheat cultivar is a semi-dwarf wheat with moderate straw strength and little lodging; has higher grain yield than all currently popular winter wheat cultivars that were tested across Nebraska; is adapted to all rainfed wheat producing regions in Nebraska; has good winter hardiness; and is at least moderately resistant to soilborne wheat mosaic virus, stem rust, and Hessian fly. Thus, NE10589 has the potential to increase productivity and profitability for Nebraska wheat farmers.

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
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
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 have sustainable food and biomass systems through adoption of best management practices (measured by percent of clientele adopting best management practices).

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Range and pasture grasses serve as the base for the Nebraska livestock industry and they are instrumental in soil and water conservation throughout the state. Nebraska has about 9.4 million hectares of grass-dominated rangeland and 1.5 million hectares of pastureland and hay land. The

demand on grazing lands by the beef cattle industry in Nebraska is increasing as the area of grazing lands declines. Pasture rental rates and market value of rangelands have doubled in the last five years. These pressures increase grazing pressure and stocking rates on grazing land as producers attempt to increase production efficiencies and their returns per unit of input. Management intensive grazing strategies (e.g., short grazing periods and high stocking densities) provide approaches to increase harvest efficiency while minimizing over-utilization of plant communities on grazing lands. For a sustainable system in which beef production is a principal objective, animal demand (stocking rate) cannot be greater than what forage plants can supply without detrimentally impacting the vegetation long-term vigor.

Nebraska leads the nation in the number of irrigated acres with approximately 3.5 million hectares. Groundwater levels have declined in some areas resulting in Natural Resources District (NRD) water pumping allocations. Irrigated row crop production has led to increased concentrations of nitrates and other contaminants in some areas of the state. Groundwater contamination has resulted in NRD groundwater quality management areas. Management of water and nitrogen application practices are crucial to the long term viability of irrigated agriculture and to maintaining adequate supplies of high quality water for animals, crops, human and ecosystem uses.

What has been done

Sandhills Grazing Research: UNL scientists conducted studies on upland Sandhills sites to determine the long-term effects of length of grazing period on annual above ground plant production, botanical composition and diversity, and distribution of grazing by beef cattle. On sub-irrigated meadows in the Sandhills, the long-term effects of stocking density on annual plant production (above and below ground), botanical composition, harvest efficiency, and average daily gain of cattle were determined.

Nebraska Extension organized and delivered irrigation water management practices to provide producers with hands-on exposure to how improved management practices can protect the environment and increase net income. New publications including irrigation and nitrogen management curricula was released in 2016 (www.water.unl.edu/waternmgt) for use by producers. A similar program was developed in the eXtension platform for use by NRD water quality and quantity management certification programs.

Results

Sandhills Grazing Research: After six years of studies, results indicate that the length of the grazing period and recovery period have a significant effect on plant community composition and production on upland sites in the Sandhills. Plant communities on upland sites remain more productive at higher stocking rates when forage removal is restricted to a three-day grazing period during the growing season, compared with season-long grazing periods. Thus, at high stocking rates, rotational grazing with 50 pastures and a three-day grazing period, compared with continuous season-long stocking (150 days) of a pasture, results in more productive plant communities. Upland range plant communities appear to be resilient to utilization, as much as 50% greater than the recommended stocking rate when using these management intensive grazing strategies. This could have a significant impact on the production efficiency of the 4 million hectares of upland range in the Nebraska Sandhills.

In addition, the grazing methods involving ultrahigh stocking densities (e.g., mob grazing or >225 animal units/hectare) do not increase above and below ground plant production or change botanical composition of pastures on sub-irrigated meadows of the Nebraska Sandhills. Although distribution of grazing is improved with mob grazing (90% use and 60% trampling), average daily gain of the grazing yearling cattle was less than that of yearlings on pastures managed by other

grazing methods. Thus, mob grazing has limited application, but has the potential to increase grazing efficiency while not affecting plant production and botanical composition.

Information collected by NRD's indicate that fertilizer nitrogen use efficiency is increasing and has reached 1.1 bushel of corn per pound of nitrogen fertilizer applied. Prolonged use of irrigation and nitrogen management practices has slowed and reversed groundwater nitrate concentrations in the central part of the state. Continued conversion of surface irrigated fields to center pivots has the potential to reduce groundwater pumping by over 4 inches in the south central portion of the state. Consequently, irrigated corn producers are producing more grain with less water and nitrogen application which reduces the potential for ground and surface water contamination issues.

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
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
307	Animal Management Systems
311	Animal Diseases
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics

Outcome #3

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 (measured by the number of farmers and commercial applicators certified in pesticide safety).

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	5031

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nebraska ranks #3 in corn for US grain production. About 80% of corn grown in the US is genetically modified to include insect resistant genes. Little data are currently available in the public sector regarding the resistance status of western corn rootworm beetles emerging from Bt-rootworm protected fields with higher than expected damage. Information is needed to understand the geographic distribution of unexpected damage to Bt-rootworm protected corn and corn rootworm resistance status at local and regional scales throughout the US corn-growing region before regulatory mitigation or remedial action is taken to confirm resistance.

What has been done
Western corn worm beetles and eggs were collected during the 2012-2014 growing seasons from cornfields in Nebraska that experienced unexpected injury to Bt-corn expressing Cry3Bb1 and in two counties that did not experience injury. Bioassays were conducted on eggs to determine the relative susceptibility of larvae to rootworm-active Cry3Bb1, mCry3A, and Cry34/35 toxins expressed in corn plants and appropriate non-Bt isolines.

The Pesticide Safety Education Program (PSEP) is an integral part of Nebraska Extension. The Nebraska PSEP program goes beyond traditional pesticide applicator audiences and includes consumers and youth learning clinics. In 2015, pesticide safety was delivered via traditional commercial/noncommercial and private applicator education programs which included an updated training manual and website. In addition, the program included a pesticide container recycling program, integrated pest management in school projects, an urban pest management conference, a mosquito and vector control association annual conference and a Nebraska Agri-Business Association custom applicator school. Version 2.0 of the Pesticide record keeping app was released with the inclusion of use by commercial applicators. Social media was used to deliver timely information via Facebook, Twitter and Flickr.

Chemigation training programs were delivered at 45 locations in Nebraska during 2015. Included in the training is information relative to pesticide label requirements and management decisions for application of pesticides via a label-approve irrigation distribution system. This program includes a training manual, calibration workbook and educational video developed in collaboration with the Nebraska Department of Environmental Quality.

Results

These studies filled a gap in knowledge about the geographic distribution of unexpected damage to Bt-rootworm protected corn and corn rootworm resistance status at the local and regional scales across the US corn growing region. Bioassay results indicated that there are heritable differences in susceptibility of western corn rootworm populations to Bt proteins. Some level of resistance to Cry3Bb1 has evolved in some Nebraska populations in response to selection pressure (i.e., repeated use of Cry3Bb1 expressing hybrids). The number of Nebraska counties where resistance to Cry3Bb1 has been documented has increased over time. Nebraska farmers will implement appropriate mitigation strategies within an integrated pest management framework to maintain sustainable rootworm population suppression and economically profitable corn production. Results of these studies also informed discussions related to development of new regulatory policies for corn rootworm resistance management among public sector scientists, EPA officials, and industry leaders.

Through close interaction among researchers, Extension Educators, stakeholders and the Nebraska Department of Agriculture high quality information was delivered to approximately 3,500 pesticide applicators, consumers, and youth. These high quality educational programs were delivered during 250 training events across the state and are vital to all Nebraska residents in terms of proper pest management, public health protection, and environmental stewardship.

Commercial/noncommercial PSEP post program surveys indicated a significant percentage of applicators indicated they will frequently or very frequently change their behaviors to the following:
* 97% Make pesticide applications according to the pesticide label
* 95% Take steps to prevent carrying pesticide residues inside their home
* 95% Use Personal Protective Equipment to protect their health
* 89% Calibrate their equipment at least once a year

A total of 2107 individuals received chemigation certification training. Of those 583 attended their first certification event, 1524 were recertified, and 12 are participating using the online training option. The certification training in conjunction with required safety equipment and field site inspections by NRD personnel provides multi-level safety net to protect groundwater and surface waters of Nebraska and beyond.

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 #4

1. Outcome Measures

Nebraska ranchers will increase sustainability of range resources through adoption of research and extension information provided by IANR programs (measured by value placed on the information by clientele).

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	34000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As of February 2016, Nebraska ranked #1 in cattle on feed; #1 in commercial cattle slaughter; #2 in all cattle and calves; #2 in ethanol production; #3 in corn for grain production; and #4 in beef cows. As recently as 2010, beef production alone accounted for more than $10.7 billion of the $22.6 billion in economic revenue generated by agriculture in Nebraska. The interdependence of beef and corn production is critical to the state. From 2006 to 2011, about 1.3 million acres of rangeland in the western cornbelt region were converted to corn and soybeans. Recently, there has been increased interest in using complementary forage crops (e.g., cover crops and other annual forages) on cropland to diversify, increase forage resources, and improve soil health. Farmers and ranchers need to balance considerations for efficiency of use and long-term sustainability of natural resources.

What has been done
Long-term corn residue grazing research was continued at three locations. Effects of various baling methods to harvest corn residue were evaluated in cattle performance trials. Summer annual forage mixtures were compared with monoculture species in a semi-arid region in a dryland cropping rotation. Forages were evaluated for dry matter yield, crude protein, and total digestible nutrients.

Crop residues, alternative crops, and regionally available by-products were evaluated as alternatives to grazing forages in beef cow production systems utilizing confinement feeding and residue grazing. Trials were conducted to determine how best to limit feed energy-dense diets containing residues and by-products to gestating and lactating cows.

Educational and learning experiences included: Range Beef Cow Symposium, Cattlemen Days,

Feedlot Roundtable, Ranch Practicum, Beef Profit Tips, Husker Beef Nutrition Conference, Husker Mobile Beef Lab and Farmers and Ranchers Cow-Calf College. In addition, the Beef.unl.edu website was accessed by 262,000 visitors and the BeefWatch Newsletter received 46,000 views.

Results

More than 10 years of studies on the effect of grazing corn residue on crop yields were summarized. Grazing corn residue had no impact on subsequent corn yields and improved subsequent soybean yields by 2 bushels per acre. Similarly, the impacts of grazing cornstalk residue in three tillage methods on subsequent crops of corn, dry edible beans, and sugar beets resulted in no change in yield of any crop when compared with corn residue that was not grazed. The quality of forage harvested as residue was improved when selecting for the husk and leaf while leaving the stem in the field. Late summer planted double-cropped annual forages comprising a mix of cool season grasses and brassicas can be a source of high-quality forage for growing calves.

Co-products and poor quality roughages make excellent diets for maintaining cows somewhere other than drought stricken pastures, allowing producers to maintain cowherd numbers during drought. The average beef producer in Nebraska maintains about 500 cows. If that producer had to sell 20% of the herd (in addition to normal culling of old and nonpregnant cows) during the 2011-2013 drought, about 100 cows would have been sold from this herd. To buy back cows and rebuild the herd would have resulted in a net loss of $52,000 in 2014 and $147,000 in 2015. Incorporation of these feeding strategies into varying management systems will allow producers to increase cow numbers without increasing land mass, thereby increasing efficiency, profitability, and sustainability of the beef industry. Participants in extension programs reported an increase in profit of $34 per head due to the knowledge gained from participating in one or more educational opportunities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
213	Weeds Affecting Plants
302	Nutrient Utilization in Animals
307	Animal Management Systems
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

Consumptive water use by irrigated crops will be reduced. The outcome measure will be the percent reduction of estimated consumptive water use when the current year is compared to the estimated consumptive water use in calendar year 2006. The consumptive water use will be estimated using the irrigation water pumped in Natural Resource Districts that require the use of water measurement devices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	87

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
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, on average, the state receives 20 inches of precipitation annually. However, annual precipitation decreases from 33 inches in the southeast to 14 inches in the west central part of the state. In addition, the timeliness of precipitation varies greatly from year to year. Consequently, crop production systems in the region are highly dependent on irrigation for economical yields and sustainability. Precision agriculture technologies such as crop canopy sensors can increase the efficiency of water used for agriculture. Scientists at UNL used crop canopy sensors and remote sensing to determine the temporal and spatial nitrogen requirements and water stress of irrigated corn. Remote sensing was also used to measure reflected light from plant canopies to quickly determine the biophysical status of plants and the effects of stress on plants over a large area. Current remote sensing methods to estimate crop productivity and water use do not account for plant response to stress or the quality of sunlight, thereby resulting in inaccurate measures of crop productivity and water use. Increased efficiency of water and nutrients for crop growth may lead to reduced use of water and fertilizer, thereby enhancing profitability and sustainability of farmers in rural Nebraska.

What has been done
Studies were conducted to determine the potential for crop canopy sensors to quantify crop water stress in irrigated corn and relate these findings to measures of available soil water. Effects of various management practices on soil properties related to nutrient cycling, water infiltration, and soil water availability were studied. The need for an algorithm for use of crop canopy sensors on irrigated corn in the semi-arid regions of Nebraska was assessed. Effects of cornstalk grazing or baling on soil physical properties related to nutrient cycling and water infiltration were determined. Studies were conducted to determine the potential for crop canopy sensors to quantify crop water stress in irrigated corn and relate these findings to measures of available soil water. Effects of various management practices on soil properties related to nutrient cycling, water infiltration, and soil water availability were studied. The need for an algorithm for use of crop canopy sensors on irrigated corn in the semi-arid regions of Nebraska was assessed. Effects of cornstalk grazing or baling on soil physical properties related to nutrient cycling and water infiltration were determined. Exchanges of energy, carbon dioxide, and water between the atmosphere and the earth surface and the light that was received, reflected, and transmitted by the crop were measured in fields of irrigated corn and rainfed corn. Leaf area, canopy height, and biomass were measured to document plant growth.

Irrigation water management educational information was delivered via Center Pivot Management Workshops, Crop Protection Clinics, Soybean Management Field Days, CropWatch Newsletter Articles, Estimated Crop Water Use Reports, and Nebraska Ag Water Management Network participant meetings. On-Farm research projects included sites under irrigation. Field demonstration of soil water monitoring equipment were conducted statewide in conjunction with NRCS and NRD personnel. In addition, mobile apps were developed and maintained dealing with Crop Water Use, Irrigation Costs, Water Meter Calculator and Pumping Plant Efficiency.

Results

Algorithms developed and used for crop canopy sensors in eastern Nebraska also functioned well in the semi-arid portions of Nebraska. Crop canopy sensors were good measures of water stress in crops; however, other methods such as soil moisture sensors, thermal sensors, and evapotranspiration gauges are more practical. Compaction of soil is not adversely affected if stocking rates are within recommendations. Baling corn residue adversely affects soil aggregation, erosion, and water runoff. The ability to estimate crop productivity and water use is vital in developing remote sensing approaches to deliver near real-time crop assessments and assess vegetation landscapes.

Educational programs reached over 110,000 individuals through direct learning opportunities and internet-based information delivery. Producers and agribusiness representatives for 3.6 million acres learned about improved irrigation water management techniques, participants in the Nebraska Ag Water Management Network increased by 12%, over 900 copies of water management apps were downloaded, and 50 on-farm demonstrational research projects were conducted. Over 900 hours of educational programs were delivered to adults and youth. Groundwater levels increased by an average of 0.53 feet in 2015. Started in 2005 with 15 collaborators, NAWMN has grown to nearly 1400 collaborators who have implemented cutting-edge water management technologies/practices on 300,000 hectares.

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
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
605	Natural Resource and Environmental Economics

Outcome #6

1. Outcome Measures

Nebraska farmers, ranchers, businesses and home owners will adopt new practices that will improve water management and protect water quality. This will be measured as the percentage of education program participants who indicate they have adopted or plan to adopt new practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	50

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The High Plains Aquifer includes many separate groundwater bearing formations in Nebraska. Approximately 65% of the overall water stored in the aquifer resides within the Nebraska state boundaries. Water quantity and quality are major issues to Nebraska citizenry. Approximately 88% of Nebraska residents rely on groundwater for their source of drinking water. As of November of 2015, over 96,000 active irrigation wells and 28,000 domestic wells were registered to remove water from the aquifer. An additional 3,000 wells provide water for public use and 20,000 wells provide water for livestock and commercial ventures.

Nebraska has a long history of monitoring, managing, and protecting the groundwater of the state. Groundwater quantity and quality are managed by 23 Natural Resources Districts to ensure the availability of a high quality water supply for uses that include human consumption, animal and crop production purposes. While most surface water originates from precipitation runoff, the Loup, Elkhorn, and Niobrara watersheds originate from groundwater discharge in the Sandhills area of the state.

The Surface waters of Nebraska are managed by the Department of Natural Resources and Department of Environmental Quality.

What has been done
Crop Management Diagnostic Clinics covered topics including soil physical, chemical and biological properties that impact soil water infiltration rates, degradation of soil organic matter, and soil water holding capacity. A total of 90 On-Farm demonstrations were conducted across the state. The demonstrations included practices to maintain crop residue on the soil surface, use of cover crops to tie up residue soil nitrogen, use of applicator based sensors to adjust nitrogen application rates, use of the Maize-N model to adjust nitrogen application, and irrigation management on soybeans. Stormwater Sleuth and Running Rain water science kits were delivered to 117 schools across Nebraska through a Nebraska Environmental Trust grant. The kits were developed to teach 4th through 6th grade students about conserving and protecting water resources. Onsite wastewater management were delivered that provided a greater depth of knowledge about the risks to water resources associated with onsite wastewater treatment systems.

Results

Participants in the Crop Diagnostic Clinics came from 7 states, 48 Nebraska Counties, represented 2.3 million hectares of land and indicated an estimated value of the information presented at $6.6 per acre. Results of participant surveys indicated that 82% indicated a moderate or significant improvement in knowledge gained about corn and soybean production systems.

Soybean management field day participants represented 5 states, 51 Nebraska counties, 145 cities and 1.3 million hectares. Post program surveys indicated that 40% of the respondents would develop a risk management plan and 44% had increased knowledge about the advantages and disadvantages of using insecticides. Approximately 69% of respondents indicated increased knowledge about making sure that applicator calibration, water quality and application practices are considered for all pesticide applications. Forty percent of respondents indicated an increased knowledge about water use efficiency.

Pre- and post-test surveys completed by students involved the Stormwater Sleuth and Running Water programs resulted in a 100% increase in awareness and understanding of stormwater issues and green infrastructure.

Survey results indicated that 84% of the respondents in the onsite wastewater treatment management programs were more knowledgeable about vulnerable sites and the importance of onsite treatment systems. Approximately 77% indicated that they intended to follow regulations for protecting water quality, watersheds and water wells when installing an onsite water treatment system.

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
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

Tornadic activity with substantial property damage was recorded in 2015. In recent years, significant flood damage has been reported along the Missouri and Platte Rivers. One of

the most significant droughts since records were maintained was experienced in 2012. Preparations for a response to natural disasters resulted in the creation of a disaster preparedness team who has initiated relationships with local, county and state representatives to develop response programs for these disasters.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNL Extension has developed an impact report for each of its Action 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

UNL 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 Action Team completes an outcome report highlighting its efforts and the impact of those efforts on clientele. 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 Action Team leaders in order 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 Wellbeing

☑ 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: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	76.0	0.0	11.0	0.0
Actual Paid	92.9	0.0	20.1	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**
1764516	0	760916	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2204846	0	538501	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; 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 are engaged in programming that best fits their needs.

Examples of program activities include:

- Workshops for childcare providers to increase their skills in developing social-emotional strengths in young children.
- Web-based learning modules/courses 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?

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. In addition, UNL 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. UNL Extension faculty also use the training and resources of eXtension to expand their skills and expertise in efforts to better serve clientele.

In 2015, Nebraska citizens using "Ask an Expert" asked 216 questions with 142 responses provided by 79 UNL Extension faculty, and 72 "Ask an Expert" questions were answered by 31 out-of-state cxtension faculty, with 40 UNL Extension faculty answering 134 out-of-state questions. Nebraska is represented by 585 eXtension members in 55 of the 68 CoPs and 17 who provide leadership for 14 CoPs.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	611100	1833300	121602	364806

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	37	53	90

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of extension in-depth workshops.

Year	Actual
2015	128

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
2015	16

Output #3

Output Measure

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

Year	Actual
2015	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase adoption of pre-harvest methods for food quality and safety.
2	Nebraska will have access to higher 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

Increase adoption of pre-harvest 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
2015	4582

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Beef and Dairy Cattle: Foodborne pathogens are reported to cause 9.4 million episodes of foodborne illness; 55, 961 hospitalizations; and 1,351 deaths annually in the US. In spite of the extensive efforts of the beef industry to ensure safety, beef products have been implicated in several large recalls although the number of large outbreaks has decreased. Foodborne bacterial pathogens of great concern for the beef industry have been Escherichia coli (E. coli) O157:H7 and more recently Shiga toxin producing E. coli (STEC).

Cereal Flours: Cereals are important staple foods in the American diet. As staples, it is important that these foods are free of microbial and chemical hazards. Examples of microbial hazards include toxin-producing E. coli and Salmonella species. These microbes do not grow in dry grain or flour, but they can stay dormant in the flour for many months. If the flour is then consumed without heat treatment, contaminated flour can cause illness. The increased incidence of foodborne disease outbreaks caused by products containing flour has highlighted the fact that the food industry cannot rely on heat treatments applied by the consumers to ensure safety of flour-based products. Therefore, strategies to reduce the microbial load of flour are needed. Cereal products can also be sources of chemical hazards, including mycotoxins, acrylamide, and heavy metals. Strategies to reduce accumulation of these toxic substances through plant breeding or food processing are needed.

What has been done

Beef and Dairy Cattle: Prevalence estimates for non-O157 STEC on the hides and pre-intervention carcasses of feedlot beef cattle were determined. Prevalence and concentration estimates for non-O157 STEC in the feces and on hides and pre-intervention carcasses of culled dairy cows were also determined.

Cereal Flours: Scientists at UNL focused on pre-milling interventions to reduce the microbial load of wheat. A survey was performed to determine the microbial contamination of wheat produced in Nebraska. Effects of weather variables following wheat flowering on the microbiological quality of wheat were evaluated over two consecutive seasons. Three hard red winter wheat cultivars were planted in three contrasting regions of the state. Additional studies were conducted to use saline and acid solutions to temper wheat to determine the reduction in microbial load of the resulting wheat.

Results

Beef and Dairy Cattle: Results suggest that non-O157 STEC that are classified as adulterants in raw, non-intact beef are highly prevalent in feedlot beef and culled dairy cattle at slaughter, further emphasizing the importance of effective pre and post-harvest interventions. UNL scientists provided the first report of disease in cattle associated with enterohemorrhagic E. coli O165:H25 infection; the oldest bovine enterohemorrhagic E. coli disease case with isolation of the pathogen and the first bovine case to demonstrate grossly evident, hemorrhagic, colonic mucosal erosions associated with enterohemorrhagic E. coli infection.

Cereal Flours: In general, microbial load in wheat grain tended to be lower in areas of the state with lower relative humidity (below 65%) and with temperatures of less than 13.7C and greater than 31.5C. The results from this project may impact grain buyers and processors. For these individuals, relative humidity and temperature following wheat flowering should be used as an additional parameter when selecting grain for higher microbiological safety.

After tempering, the initial microbial load was significantly reduced by all the acid and sodium chloride treatments when compared with controls. The combined lactic acid and sodium chloride effects on reducing aerobic plate counts and Enterobacteriaceae counts were greater than any single or paired treatment, which suggests a synergistic interaction. This project may impact grain processors by affording them a strategy to produce flour with higher microbial safety. The milling process of hard wheat tempered with organic acids and saline solutions may provide milled products with improved microbiological quality when compared with the traditional tempering process using water.

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 higher 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
2015	42450

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The mission of Nebraska 4-H is to empower youth to reach their full potential while working and learning in partnership with caring adults. Nebraska 4-H strives to help young people achieve their greatest potential by introducing high-quality youth development experiences into the lives of Nebraska youth and families. Engagement in 4-H results in youth who are making positive decisions related to their health and their future goals. Further, they are advocates and leaders determined to leave a lasting impact on Nebraska communities.

By taking part in Nebraska 4-H, youth are preparing for a successful future by focusing on 4-H Science, Agricultural Literacy, Career Development and College Readiness, Citizenship and Leadership, and Healthy Living. Impact statements below represent youth responses collected at many county, district, and state programs. Approximately 3,250 responses were collected with state-level surveys. An additional 4,800 responses were collected using the National 4-H Common Measures instruments.

What has been done
Program efforts in each of the six areas follows:

Nebraska 4-H is developing science interests, skills, and abilities in the areas of agriculture, energy, environmental stewardship, and technology. Signature program efforts include Outdoor Skills in partnership with Nebraska Game and Parks, GEAR-Tech 21 Robotics, Animals Inside and Out, Embryology, Corral Your Future, Animal Science Day Camps, and Companion Animal programs. Programs were delivered to nearly 3,000 young people.

Nebraska 4-H is helping youth focus on their future success and preparing youth to make informed decisions about their college and career path. Youth gain an understanding of the

opportunities within their own communities and the importance of the choices they make in high school. Signature program efforts include Connecting the Dots, Big Red Summer Camps, Building Your Future, Leap into Careers, and other college readiness programming delivered to more than 4,550 youth across the state.

Nebraska 4-H ensures that youth have knowledge and an appreciation of agriculture, Nebraska's largest industry. Signature program efforts included the Ag-Citing Science school enrichment program delivered to nearly 1,200 youth and Agricultural Literacy Festivals, which reach more than 7,000 young people.

Nebraska 4-H is fostering youths commitment and contributions to their communities. Signature program efforts include Build Your Future, LEAP into Careers, 7 Habits of Highly Effective Teens, We the People, and Focus on Citizenship, which reached approximately 1,600 young people. UNL Extension's Raising Nebraska Experience is a 25,000 square-foot interactive display space designed to help youth and adults understand where their food comes from along, with the science involved in food production. Raising Nebraska engaged over 3,000 youth in 10-hour learning experiences in 2015 and had over 150,000 visitors. In addition, Raising Nebraska won first place in its category in the 2015 International Association of Fairs & Exhibitions competition.

Nebraska 4-H helps youth understand the impact of personal decisions. Signature program efforts included 4-H Healthy U, the Healthy Living Skill-a-thon, and a new 4-H Foods Contest at the Nebraska State Fair. These programs reached approximately 4,000 youth. Additionally, hands-on activities in the areas of nutrition, physical activity, hand washing, food preservation, food preparation, and decision making were delivered to nearly 18,000 youth.

Nebraska 4-H is committed to preparing youth to pursue a post-secondary education. Annually, former 4-Her's who participated through their high school career are surveyed regarding their post secondary plans after their first semester in college.

Results

In Nebraska, one in three age-eligible youth across all 93 counties are enrolled in 4-H, for a total enrollment of approximately 140,000 youth. Of those youth, nearly 56,000 participated in school enrichment experiences; over 25,000 Nebraska youth were members of a 4-H Club; and nearly 8,000 youth and adults participated in 4-H camping programs. In addition, 12,000 volunteers shared their time and resources with Nebraska 4-H.

Results of specific program efforts follow:
- 93% of youth in the GEAR-Tech 21 program are excited to learn more about science and two in three youth are interested in a career in science.
- 79% of youth in Animals Inside and Out can successfully identify multiple animal by-products and 69% reported an increased interest in Animal Science.
- 94% of youth in the Outdoor Skills program agree that science is important in solving everyday problems, and 86% learned problem-solving skills they can use in school.
- 97% of youth participating in Connecting the Dots understand their opportunities for post-secondary education in Nebraska, a 22% increase from before the program.
- 64% reported an interest in attending the University of Nebraska-Lincoln in the future.
- 70% plan to live and work in Nebraska after college.
- 87% of youth were able to correctly identify the source for milk, vegetables, proteins, and grains.
- 72% of youth knew agriculture is the largest industry in Nebraska.
- 79% of youth could identify someone they know who has a career in ag.
- 80% of youth in the 7 Habits of Highly Effective Teens have developed a personal mission statement and goals; an increase of 31% from before the program.

- 86% of youth in community engagement programs report that they value differences in others.
- 94% of youth report having an opportunity through 4-H to contribute to their community.
- 89% know the value of a healthy, balanced diet.
- 85% reported plans to encourage their families to eat meals together.
- 92% learned how to deal with stress in a positive way.
- 96% are pursuing post-secondary education.
- 22% are attending the University of Nebraska-Lincoln.
- In 2015, approximately 400 volunteer shooting sports instructors reached more than 35,000 young people in Nebraska and delivered an impressive 41,500 hours of instruction. Nebraska 4-H is also the current host of the 4-H Shooting Sports National Championships, expanding the reach of our volunteers to 500 more youth from across the country.

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
2015	48450

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nebraska ranks 10 in the United Health Foundation's America's Health Rankings for 2015. Obesity increased to 29.6% and diabetes increased by 10% from 8.4% to 9% of adults. 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:
- new data released by the U.S. Census Bureau (September 2015) indicates more than 6,000 fewer Nebraska children are living in poverty. Overall, Nebraska child poverty fell 1.5 percent, from 17.7 percent in 2013 to 16.2 percent in 2014.
- immunization coverage among children increased by 9% (from 79% to 80.2%) of children ages 19 months to 35 months. Nebraska has the second best child immunization coverage in the nation.
- preventable hospitalizations decreased by 13% (from 63.8 to 55.8 per 1,000 Medicare beneficiaries).
- In the past year, physical inactivity decreased 16% from 25.3% to 21.3% of adults.
- In the past two years, smoking decreased 12% from 19.7% to 17.3% of adults.

What has been done
The Nebraska Food, Nutrition and Health Action Team focuses on improving nutrition, physical activity, health management, and food safety outcomes. In 2015, approximately 42,800 youth and 213,000 adults were reached through direct and indirect education methods for a total of 255,800 Nebraskans. Approximately 50 team members (specialists, educators, coordinators, and assistants) located statewide are providing food, nutrition, and health programming to audiences through a variety of teaching methods, helping reach extension's mission of enhancing Nebraskans' lives through research-based education.

Food, Nutrition and Health Program participants are impacted through one-on-one education, group settings, health fairs, on-line and distance programs, social media outreach, newsletters, blogs, webpage development, mobile applications, and media. Grants with statewide and multistate partners focus on childhood obesity, school wellness, food safety, and food security. Examples of programs delivered in 2015 include.
- Healthier eating patterns. Youth and adults increased fruit and vegetable, whole grain, lean protein, and low-fat dairy intake through programming. Adults were reached through worksite wellness, Cooking Matters, Discovering Food, community groups, conferences, and senior programs. Youth were reached through iCook, 4-H Food Smart Families, and KidQuest.
- Increasing physical activity. Youth and adults increased and/or met activity recommendations because of program participation. Adults were reached through programs focused on AgrAbility, Pilates, and Tai Chi. Youth were reached through programs such as FitnessGram, Eating Smart Moving More, and Blender Bikes.
- Improving health management. Adult audiences were assisted with health management through programs such as Medicare education, Control Diabetes for Life, and National Diabetes Prevention.
- Safer food practices. Participants (food service managers, employees, day care providers, general public, youth) learned and implemented safer food practices through programs such as ServSafe, Discovery Neighborhood, Microwave It!, and food preservation classes.

Results
Program examples and their results follow.

Healthier Adults
- Approximately 205,700 adults reached through direct and indirect education methods.
- 6,330 adults reached through SNAP-Ed and EFNEP.
- 142 providers from 37 child care centers/homes participated in NAP SACC.

Healthier Youth

- 14,637 youth participated in nutrition, physical activity, food preparation, and food safety programs.
- 1,100 youth participated in the 4-H Food Smart Families program.
- Over 23, 900 youth participated in SNAP-Ed and EFNEP programming.

Improving Food Safety Practices
- More than 1,200 food service managers and food workers participated in ServSafe® programming.
- Over 3,000 youth participated in hand washing programs.
- Over 175 youth and adults were reached with Discovering Foods programming.

Growing Healthy Kids through Healthy Communities is a school eEnrichment program (K-2) developed to increase nutrition/health knowledge and change behavior (USDA funded grant). Growing Healthy Kids (GHK) targets K-2nd grade children (ages 5-8), their parents, and teachers. GHK uses educational kits specifically developed for each grade (K-2) with age-appropriate curriculum and activities. Over 17,000 K-2 students were reached in the Lincoln Public Schools (LPS) system during the four year grant period. A significant increase in nutrition knowledge for all grades and improved nutrition-related behaviors reported by parents and teachers were found. The GHK School Enrichment Curriculum was adapted from the SNAP-Ed School Enrichment Kits and reaches all K-2nd students in LPS.

The 11th Annual Food Safety Task Force Conference focused on Avian Influenza, Norovirus, Food Allergies, and Food Waste. Participants included food safety experts from the Nebraska Departments of Agriculture, Health and Human Services and Education; grocery stores (retail food), restaurants, and extension. An increase in knowledge was reported for all topics presented.

The 4-H Food Smart Families team in Nebraska reached over 1,100 youth and created over 25 community partnerships across the state. Nebraska 4-H Food Smart Families is engaging families in the learning process through family and community engagement (FACE) events, which have included picnics, fairs, and celebrations. The FACE events have involved activities such as parents and youth cooking and eating together, discussing and practicing food budgeting, and participating in physical activities. Because of participating in the 4-H Food Smart Families program.
- 93% of youth agreed/strongly agreed they learned how to make healthy food choices.
- 88% of youth agreed/strongly agreed their family has prepared healthier meals.
- 88% of youth agreed/strongly agreed they learned cooking skills.
- 81% of youth agreed/strongly agreed they learned skills for buying food on a budget.

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 wellbeing. UNL 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, UNL 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

UNL Extension has developed an impact report for each of its Action 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

UNL 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 Action Team completes an outcome report highlighting its efforts and the impact of those efforts on clientele. 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 Action Team leaders in order 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.