# 2016 University of Nebraska Combined Research and Extension Annual Report of Accomplishments and Results

**Status: Accepted**

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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 the residents of the state. In 2011 strategic two-way dialogue moved to a new, higher plane as Vision for 2025 was implemented. 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 three 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.

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. Continued listening sessions, surveys, departmental reviews, and input from advisory groups helps 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 non-formal 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 non-formal settings, and in the placement of graduates in careers.

**Total Actual Amount of professional FTEs/SYs for this State**

| Year: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 228.0 | 0.0 | 140.0 | 0.0 |
| Actual | 232.8 | 0.0 | 146.1 | 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, comprised of 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 by state commodity check-off boards of more than 100 research and extension proposals. 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 multi-state projects receive research funding through the multi-state 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 multi-state activity.
- ARD internal competitive grant funding includes external stakeholder review.

**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 addresses 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 is 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 & Intercultural Development Inventory (IDI)." The success of these pilot sessions has led to training three more extension faculty as facilitators and offering additional training's, which includes individual coaching sessions for participants in the coming year.

**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 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 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, 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 |
| 5125957 | 0 | 4299068 | 0 |

| 2. Totaled Actual dollars from Planned Programs Inputs | | | | |
|---|---|---|---|---|
| | Extension | | Research | |
| | Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| Actual Formula | 4852356 | 0 | 4326639 | 0 |
| Actual Matching | 5125957 | 0 | 4391650 | 0 |
| Actual All Other | 0 | 0 | 0 | 0 |
| Total Actual Expended | 9978313 | 0 | 8718289 | 0 |

| 3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous | | | | |
|---|---|---|---|---|
| Carryover | 955891 | 0 | 1489139 | 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: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 152.0 | 0.0 | 129.0 | 0.0 |
| **Actual Paid** | 136.9 | 0.0 | 131.7 | 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** |
| 3059077 | 0 | 3841850 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 2810150 | 0 | 4017720 | 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 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 District 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 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 2016, Nebraska citizens using "Ask an Expert" asked 237 questions with 155 responses provided by 74 Nebraska Extension faculty; 84 "Ask an Expert" questions were answered by 49 out-of-state extension faculty; and, 38 Nebraska Extension faculty answered 181 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.

An example of an eXtension initiative led by Nebraska faculty is: 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/). A national team of land-grant university experts was assembled for the writing and pilot testing of the course.

## V(E). Planned Program (Outputs)

### 1. Standard output measures

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 453909 | 1361727 | 143510 | 305012 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 31 |

**Patents listed**

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 169 | 274 | 443 |

## 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 |
|---|---|
| 2016 | 89 |

**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 |
|---|---|
| 2016 | 848 |

**Output #3**

**Output Measure**

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

| Year | Actual |
|---|---|
| 2016 | 39 |

**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 |
|---|---|
| 2016 | 7 |

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Nebraska farmers 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 cattle producers will increase profitability and sustainability of range resources and other inputs 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 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 |
|---|---|
| 2016 | 18654125 |

### 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. Nebraska is the third largest producer of corn in the country, second in ethanol production and distillers' grains, second in cow-calf production and calf production and first in cattle on feed. Cattle outnumber people in Nebraska more than three to one. Every part of a cow is used for a wide variety of products, including leather, fishing line, biodegradable outboard motor oil, pet chew toys and gummy candies.

The recent downturn in the agriculture economy, low commodity prices, and high input costs, are challenging for livestock and row crop producers.

**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

**Results**
Ranching for Profitability Meeting Series: The goal for this meeting series was to address current issues impacting ranchers' profitability across the state. Responses from end of the meeting evaluations indicated:

-82% were likely to make changes from knowledge gained.
-$8 estimated improvement in profitability per head of cattle managed by participants.
-200,000 cattle managed by participants.
-700,000 acres managed by participants.
-$1.3 million estimated benefit by participants to their operations in the state

Cornhusker Economics 2016 Outlook Meetings had the goal of providing current situation and outlook information on production, markets, finance, and policy to enable producers to make sound, informed management decisions for 2016 and beyond. Targeted to producers, landowners, agricultural professionals, and students -- 124 participants in six locations for 2016. Evaluations from these participants indicated:
* Improved ability to understand forces influencing the agricultural economy.
* Enhanced decision making by better interpreting economic trends.
* $898,000 overall estimated impact to workshop participants.

The average impact of the meeting series was $7,240 per participant, or a total of nearly $12,909,000 for the 1,783 participants in 55 meetings over the 10 years of programming.

**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 |
|---|---|
| 2016 | 85 |

### 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.

**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.

**Results**
Project SENSE focuses on improving the efficiency of nitrogen fertilizer use and prevent leaching into the underground water system. Nebraska Extension is working directly with producers in conducting research trials on their own fields.
-106k acres influenced by producers.
-705k acres influenced by advisors.
-$475k = estimated value by producers.

Lagoon Closure Demonstration Event where attendees reported significantly ($p<.05$) increased confidence in making decisions relevant to planning and executing a manure storage closure.

### 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 |
|---|---|
| 2016 | 9126 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
In cropping systems, biotic stress from competing organisms can reduce yield and quality. Conversely, resistant crops cause stress to pests and pathogens and protect yield and quality. Stress Biology approaches ranging from basic molecular and genetic analyses through field studies of ecological interactions are increasing our understanding of how crops, pests and pathogens cause and respond to stress. The broader implications and outcomes are to understand 1) how organisms respond and adapt to stress, 2) how stress might be manipulated to improve pest and disease control, and 3) how abiotic and biotic stress mitigation can be incorporated into crop genetics.

**What has been done**
Below ground fungal and bacterial plant and insect pathogens were tested for pathogenicity to hosts and for response to abiotic stressors such as fungicides. Populations of a soil insect pest, the western corn rootworm, were tested for cross-resistance among plant-incorporated BT toxins and a commonly used synthetic insecticide. Investigations of the potential of sublethal fungicide exposures to cause stress-induced mutations at local and broad regions of the fungal genome that may condition fungicide resistance are ongoing. A breeding program is incorporating multiple disease resistance and drought tolerance into high yielding great northern and pinto bean lines adapted to western Nebraska and the High Plains region.

**Results**
In the first comprehensive research study of Rhizoctonia on soybean in Nebraska, we have processed more than 650 soil and plant samples, resulting in a collection of 23 Rhizoctonia spp. Using ITS sequencing, we determined the 2015 isolates were predominantly R. zeae; in 2016 we detected isolates of both AG5 and R. zeae. Testing is currently underway to confirm pathogenicity. By understanding where and why soilborne diseases occur and possible problems with fungicide resistance, we will develop recommendations to optimize soil health and crop productivity. We are also finding that fungal plant pathogens receiving sublethal fungicide exposures may have stress induced mutations at local and broad regions of their genome that condition fungicide resistance.

In recent years, increasing insecticide applications to larval and adult western corn rootworms (WCR) has caused concern about potential for resistance developing to a primary insecticide, bifenthrin.

Results suggest that multiple WCR mechanisms of resistance may be involved in bifenthrin resistance. These include a kdr-like mechanism of resistance (reduced sensitivity of voltage-gated sodium channel target site) and increased metabolic detoxification. To facilitate further studies, a non-diapause bifenthrin resistant WCR lab colony has been established. The level of resistance in the reselected colony is similar or exceeds the LC50 of many resistant field populations.

A comprehensive breeding program to improve dry bean tolerance/resistance to abiotic and biotic stressors is underway. A great northern cultivar, 'Panhandle Pride,' with multiple disease resistance was released that will require fewer crop protection chemicals and, will have reduced environmental impacts and production costs. Work toward studying the genetics and mapping the genes of bacterial wilt resistance and transferring bacterial wilt resistance into Nebraska elite dry bean lines continues. Recombinant inbred lines are being advanced through single seed descent and hybridization is introducing bacterial wilt resistance. The lines are fingerprinted to several molecular markers for multiple disease resistance. Simultaneously, we are introgressing drought

tolerance into the Nebraska elite germplasm and identifying drought tolerance QTLs to improve further selection. Shuttle breeding between Puerto Rico and Nebraska is expediting selection for multiple stress tolerance (drought/heat) and multiple disease resistance (common blight and rhizoctonia root rot).

**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 cattle producers will increase profitability and sustainability of range resources and other inputs 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 |
|---|---|
| 2016 | 20000000 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**
Nebraska ranks 4th nationally in total number of beef cows, number of head, Jan. 1, 2017 -- 1,920,000. Nebraska's farms and ranches utilize 45.2 million acres 91% of the state's total land area. There are nearly 23 million acres (9,307,770 ha) of rangeland and pastureland in Nebraska -- half of which are in the Sandhills.

**What has been done**
Interactive programs and conferences were developed to address grazing systems as they relate to forage utilization and plant populations to reduce soil movement. Also addressed were fencing and water development to enhance-grazing distribution, which results in more efficient use of forage and reduction of overgrazing and soil exposure.

**Results**
Nebraska grazing conference: impacted 52,226 head of cows, 17,408 stockers and 11,625 feedlot cattle, and impacted 371,023 acres of pasture, 23,053 acres of hayland, and 71,076 acres of cropland. Producer Extrapolated Data: 20,551 head of cows and 12,409 head of stockers at $16.61 per head savings would become a total reported savings of $547,466. Consultants represented 36,500 head of livestock and 110,000 acres. In regards to management changes: 77% Likely; 19% Very Likely
Cover Crops Field Days and Programs: Participants learned about planting and managing cover crops by attending.
-Valued by participants at $17.4 million.
-100% of survey respondents were likely to make changes based on the information presented.

**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 |
|---|---|
| 2016 | 87 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Nebraska is first in the nation in irrigated acreage and is ranked fourth in ground water use in agriculture. However, water use in irrigated cropping systems is challenged by anthropogenic changes affecting climate and by competition between agricultural and community water use, the primary users. As atmospheric CO2 concentrations increase, precipitation, temperature, and humidity patterns will also change, and the amount of water needed to maintain agricultural productivity will grow. Unfortunately, in response to irrigation water withdrawals, groundwater levels have declined significantly in several major irrigated areas of the state. Also, groundwater decline can have impacts on streamflow, which is important for endangered species and interstate compacts. Efficient and equitable water use will depend on the predictability of current and future states of water availability. We also need a sound understanding of the impacts of climate variability on carbon sequestration, water use, and food production to develop mitigation strategies and to evaluate the long-term sustainability of agroecosystems.

**What has been done**
In-situ and remote sensing is being used to collect data to improve our understanding of water use and crop stress at field-level and regional scales across variable environments in Nebraska. To understand field-level and regional water need in irrigated cropping systems, we have installed cosmic-ray neutron probes to collect hourly soil moisture data from sites across Nebraska. An online app, a decision support tool, is being used to assist cropping systems managers make efficient irrigation decisions and allows comparisons between predictions of the program and field observations and measurements. Data collected by remote sensors can quickly ascertain crop biophysical status, productivity, and water use over large areas. The sensors measure changes in sunlight absorbed and reflected light patterns to determine the biophysical status of the plants, to identify periods of stress, and water use over large areas.

**Results**
In 2016 we obtained year-round measurements of energy, carbon dioxide and water exchanges from three field-scale sites (irrigated continuous maize, irrigated soybean, and rainfed soybean) in Nebraska. We also measured light received, reflected, and transmitted by the crop to determine photosynthetically active radiant flux, a measure closely related to productivity. These measurements are improving our understanding of the influences of crop stress on retrieval of remotely sensed crop biophysical parameters and are assisting in quantifying crop productivity.

Advancements in sensing and data analysis are improving our understanding of crop productivity and water use interactions. We can remotely determine crop phenological status, stress, and biophysical status using a combination of leaf- and soil-level measurements and ground- and satellite-based sensor platforms. Analysis is enhancing our ability to identify the start of the growing season through daily NEE fluxes and our understanding of the processes and spectral signatures needed to estimate Gross Primary Productivity (GPP) and evaoptranspiration in crop systems. Including impacts of diffuse light and stress (plant photoprotective mechanisms) and their interactions with plant phenology as an initial step is improving estimates of C assimilation and transpiration of plant canopies.

Overall, our remote sensing approaches are delivering near real-time crop assessments and will offer the opportunity to extend assessments to larger-scale (county, state, multi-state) vegetation landscapes. Other impacts have been changes in knowledge with the publication of peer-reviewed papers, conference proceedings, presentations, and a peer reviewed extension website. The CornSoyWater app is being used by more than 1,000 registered users to make irrigation decisions for corn and soybean fields.

**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 |
|---|---|
| 2016 | 50 |

**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. Dry climate conditions, combined with a large availability of ground water, have led to crop production systems that are highly dependent on irrigation for maximum yields and sustainability. Elevated societal demand for water (quantity, as well as quality) has become increasingly important locally, regionally, nationally, and globally. The appropriate use and

intelligent management of groundwater resources are key components and are critical to the near, and long term future of Nebraska's economy. Many communities in Nebraska rely on groundwater for their water supplies. Municipal use of groundwater represents one of the highest priorities for water. However, agricultural production is a key element of the Nebraska economy and is the largest user of water resources, including groundwater. Globally, agriculture accounts for nearly 70% of freshwater usage worldwide. Competing agricultural and community needs, along with ecosystem and environmental demands, require resilient and sustainable management of Nebraska's water resources. Efficient municipal water treatment can be used to recharge groundwater supplies for reuse. Much of Nebraska's groundwater resources are in the High Plains Aquifer (part of the Ogallala Aquifer that extends from Nebraska to Texas).

It is well understood that groundwater depletion is occurring in many parts of the world and that policy and regulations influence long-term sustainability of water resources. In the High Plains Aquifer, groundwater management varies with considerable heterogeneity among local jurisdictions. Despite this, there has been no rigorous examination of differences in rules and aquifer conditions across a large region such as the High Plains Aquifer. Understanding those differences is critical in determining how to design regulation. The societal benefits will include improving the sustainability and economic viability of groundwater irrigated agriculture in the High Plains region and other groundwater irrigated regions of the world.

**What has been done**

Deployed sensor networks linked with predictive modeling are yielding an improved understanding of resilience and adaptive management linkages between municipal water discharge and groundwater quantity and quality in Nebraska, and are resulting in developing decision-support systems beneficial to watershed managers challenged by management of non-point source pollution across watersheds.

Natural Resource District (NRD) water use policies have changed over time. We have collected individual, well, or field-level data information from the NRDs and combined data to evaluate differences across space and NRD. Kansas has a single repository for all groundwater use information, which facilitates collecting that information. The data is being combined with groundwater use and policy information, climate data from PRISM, hydrological information from USGS, and soil data from SSURGO. The Landscape Position Study (year 5) is being replicated in Colorado and Oklahoma with the goal of educating producers on the use of crop canopy sensors.

**Results**

Improved knowledge about management of groundwater and watersheds with respect to onsite wastewater is estimated to enhance resilience of water resources through proactive protection of about 286 million gallons of groundwater in Nebraska annually. The focus on crop irrigation and nonpoint source pollution has the potential, through more efficient use and protection of water resources, to reduce the level of conflict between community, agricultural irrigation, and environmental and ecosystem interests. The combined Nebraska and Kansas data is available through a web interface that researchers and policy makers can use to learn more about groundwater use and policies across different administrative districts.

The Nutrient Management Project focuses on increasing nutrient and water use efficiency for crop production in the semi-arid environment of west-central Nebraska. It also examines the effects that current and potential future agronomic management practices have on soil properties related to nutrient cycling, water infiltration, and soil water availability. Results to date from the Landscape position study suggest that crop canopy sensor algorithms developed and used in the eastern portion of Nebraska also function well in the western semiarid portion of Nebraska. There is no need to develop specific eastern and western Nebraska algorithms. The sensors can determine water stress in crops. However, the practical application is limited at this time, and other

technologies may be more practical. Other findings suggest that baling of corn residues can adversely affect soil aggregation as well as erosion and water runoff. The overall impact of this project increases input use efficiency while negating potential environment degradation, thereby decreasing the impact of agriculture on important natural soil and water resources.

**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 2016 in the spring and also, late fall. Many instances of strong thunderstorms with high winds and damaging hail (up to 2 inches in diameter) affected many crops across the state in April and May. Nebraska saw extreme weather in terms of climate with summer temperatures topping the century mark and low temperatures plummeting well below zero. Precipitation amounts ranged from only a few hundredths for an entire month to over 7 inches in a 24-hour period. Though there was rain, the year closed with a significant increase in abnormally dry, moderate drought or even severe drought conditions across about half of the area, especially in the west.

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 that has initiated relationships with local, county, and state representatives to develop response programs for these disasters.

## 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/.

## 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: 2016 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 76.0 | 0.0 | 11.0 | 0.0 |
| Actual Paid | 95.9 | 0.0 | 14.4 | 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 |
| 1793279 | 0 | 484789 | 0 |
| 1862 Matching | 1890 Matching | 1862 Matching | 1890 Matching |
| 2315807 | 0 | 373930 | 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 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?**

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 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 2016, Nebraska citizens using "Ask an Expert" asked 237 questions with 155 responses provided by 74 Nebraska Extension faculty; and 84 "Ask an Expert" questions were answered by 49 out-of-state extension faculty; and, 38 Nebraska Extension faculty answered 181 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**

| 2016 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 452576 | 1357728 | 222759 | 448522 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2016 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2016 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 150 | 42 | 192 |

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of extension in-depth workshops.

| Year | Actual |
|---|---|
| 2016 | 130 |

**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 |
|---|---|
| 2016 | 11 |

**Output #3**

**Output Measure**

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

| Year | Actual |
|---|---|
| 2016 | 9 |

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Increase adoption of preharvest 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 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 |
|---|---|
| 2016 | 4582 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**
Food consumers care what they eat and what they feed their children. Food safety is an important public health priority. Foodborne illness (sometimes called "foodborne disease," "foodborne infection," or "food poisoning) is a common, costly -- yet preventable -- public health problem. The Centers for Disease Control and Prevention estimates that each year roughly 1 in 6 Americans (or 48 million people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases.

Cereal crops, which make up the major foodstuff of people around the world, have the potential to reduce agriculture's environmental footprint and to provide enhanced nutritional value. Wheat and sorghum are examples of cereal crops with relatively low input needs but they have specific nutritional deficiencies. The first approach is to improve essential nutrient quality (amino acid deficiency), digestibility (reduced proportion of kafrin proteins), and to boost specific dietary fibers to obtain targeted health benefits; for example, sorghum with a complete protein profile and fiber intake for people with celiac and non-celiac gluten intolerance. Cereal fiber intake also has the potential to shift gut microbiota profiles from those associated with obese persons toward those of healthy weight individuals. We are also developing strategies to deliver the improved crops to consumers in a palatable, desirable form.

**What has been done**
Nebraska Beef Quality Assurance (BQA)

BQA strives to strengthen consumer confidence in a safe, wholesome, quality beef product through educating all people involved in beef production to implement science-based good production practices to ensure proper animal care and welfare from conception to consumers' plates. Nebraska Extension has teamed with Nebraska Cattlemen, and the Nebraska Beef Council to hire an educator to serve as the director of beef quality assurance (BQA) for the state

of Nebraska. This educator provides leadership for BQA efforts and programming statewide. More information can be found at: http://beef.unl.edu/.

One example of programming is Livestock Quality Assurance. A self-directed course designed for youth ages 8-18. Participants learn about the quality of meat and food products that come from livestock to increase awareness and overall animal care and comfort on dairies in Nebraska.

Cereal Crops

Functional genomic editing tools and throughput genetic screens applicable to the diploid sorghum genome were developed. The techniques are being used to produce sorghum varieties with improved lysine content and to target the kafrin storage proteins to increase protein digestibility.

Wheat cereal dietary fibers were tested for their capacity to alter gut microbiota (promote blooms of gut bacteria genera associated with reduced body and adipose tissue weight) and to improve metabolic markers (increased glucose metabolism). In addition, cereals being grown in different conditions are being selected for improved dietary fiber profiles and palatability traits.

**Results**
Nebraska Beef Quality Assurance (BQA)

Post-training survey on BQA
- 9,700 producers are BQA certified in Nebraska.
-89% of all participants have implemented or plan to implement BQA Best Management Practices.
-93% of participants expressed moderate or significant knowledge gained in Antimicrobial Stewardship, Best Management Practices, Veterinary Feed Directive and Animal Handling.
-46% estimated at least a $5.00 per head increase in profitability from BQA implementation.

Veterinary Feed Directive post-education survey:
- 96% of producers who participated in educational workshop gained moderate to significant knowledge about the new VFD regulation.
-10% of producers have already implemented best management practices to comply with the regulation
-76% plan to make changes

Cereal Crops

The gene editing techniques targeting the multi-copy, alpha-kafirin family (responsible for the poor digestibility of sorghum) resulted in a number of novel increased digestibility, high-lysine variants. Analysis showed general or specific reductions of kafirin proteins while showing increases in the non-kafirin protein fraction. We are currently propagating M3 plants from all of the putative protein altered mutants for measurement of lysine content and digestibility.

Mice fed a high-fat diet with and without dietary fiber from select hard red wheat varieties differed in fermentation rates and short-chain fatty acid production. The inclusion of dietary fiber improved glucose metabolism and blooms of bacterial genera associated with decreased body and adipose tissue weight. These results demonstrate that dietary fiber can induce improvements in weight gain and metabolic health in mice. The results could also impact breakfast cereal and snack producers looking to use alternative grains and to market healthier profile products.

### 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 |
|---|---|
| 2016 | 50149 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
4-H Grows Here... Empowering youth with the skills to lead for a lifetime.

In Nebraska, 4-H reaches one of every three age-eligible youth and engages youth and families in all 93 counties. As positive youth development professionals, we strive to prepare youth for their successful futures through Career Development and Healthy Lifestyles. We engage them in STEM (Science, Technology, Engineering and Math) and Agricultural Literacy efforts that will enable them to lead these industries in the future. And, we empower their unique Leadership skills and Entrepreneurial spirit that will ensure they make a lasting and positive contribution to their communities.

**What has been done**
To ensure that extension efforts are creating and leading research-based leadership development

programming, a framework based on contemporary leadership research was created in 2016 to serve as a foundation for future programming.
Over 1600 youth and over 260 adults have been engaged in leadership development activities during 2016 that have:
* Increased awareness and ability to be an effective leader.
* Maximized collaborative effectiveness of leaders by developing teamwork capabilities and working towards a goal.
* Engaged in service learning and community development efforts that have led to community impact.

Nebraska Extension is helping to grow future scientists, programmers, and engineers. Hands-on STEM learning helps youth explore interests and develop a curiosity in science, technology, engineering, and math. An early interest in STEM is linked with an increased likelihood of a person going into a STEM-related career field. Future scientists are critical in maintaining and improving our local communities. In order to prepare our future STEM professionals, youth formal and non-formal educators must be ready to meet the needs of the youth.

Nebraska Extension is connecting Nebraska youth to important careers and strengthening entrepreneurship skills. Entrepreneurship is crucial to the economic vitality of all communities. It also is one mechanism used to affect business creations and influence perceptions of entrepreneurial careers. Research shows that educational programs focused on non-cognitive entrepreneurial skills are best developed at an early age and have spill-over effects to subsequent entrepreneurial knowledge and skill development in later years. (Huber, 2014). Youth in lower secondary levels of education show higher entrepreneurial intentions when taught cognitive entrepreneurial skills. (Moberg, 2014). Youth will benefit from extension programming that provides real-life experiential learning and entrepreneurial opportunities.

The Youth Entrepreneurship and Business Opportunity Issue Team (YEBO) consists of 30 Nebraska Extension staff statewide. This team created three curriculums that target a range of grades and present learner engagement through hands-on activities:
* Tec Box -- Elementary Youth -- A Makerspace Program, where youth invent a new product and explore entrepreneurship.
* Inventure Day -- Middle School -- A daylong entrepreneurial adventure for youth to increase their knowledge of local businesses, business owners, and community opportunities while exploring potential entrepreneurial careers.
* Sprint Startup -- High School -- Intensive experience in which youth are immersed in learning and collaborating to launch a business and pitch it to potential investors.

**Results**
Nebraska Extension ensures that youth will be better prepared to make decisions regarding their higher education and career paths, resulting in an increased ability to make positive contributions to the community. Below are the highlights of 2016.

CONNECTING THE DOTS is a career exploration program that helps 9th and 10th grade students learn about careers of interest as well as how to "connect the dots" from high school through post-secondary study to the workplace. Students experience a "real life" simulation to learn how their high school choices impact their post-secondary study and their workplace experiences.
* In 2016, over 1,500 youth participated in 11 programs across the state.
* In total, more than 140 community partners were engaged. They represented the 16 Nebraska Department of Education career clusters highlighted during each program.
* 90% of youth found a connection between their interests and a career area with 63% planning to

live and work in Nebraska.

ACADEMIC SUCCESS, developed in partnership with the UNL First Year Experience resource, is a program designed to boost success for junior and senior high school students and prepare them for their post-secondary plans.
* Five programs: Study Skills, Time Management, Note Taking, Reading Strategies, and Procrastination & Motivation.
* Time Management and Study Skills programs were piloted in 17 school districts, reaching 343 youth in the spring of 2016.
- 97% of students identified one new type of time management strategy.
- 94% of students identified one new study strategy to help them finish high school and prepare for college.

NEXT CHAPTER at Nebraska is a college readiness and UNL pre-admittance program sponsored by Nebraska Extension in partnership with University Admissions that offers all 8th grade students enrolled in the Nebraska 4-H club program pre-admittance to the University. Additionally, throughout high school, these students engage in events, activities and curriculum where they participate in career exploration, develop research skills, and experience a variety of learning methods that will help them transition to and succeed in college.
* In Omaha, Nebraska's largest city, the Next Chapter program is a partnership between Omaha Public Schools (OPS), Nebraska Extension, 4-H and the University of Nebraska-Lincoln Office of Admissions.
* Approximately 1,900 OPS eighth graders will be receiving pre-admittance letters in 2017.

BIG RED SUMMER ACADEMIC CAMPS are residential, career exploration camps held on the UNL Campus. By participating in a camp, youth get the opportunity to explore campus, learn from UNL faculty and staff, and spend time investigating an interest or potential career.
* In 2016, 85 youth participated in eight camps: Computer Science, Weather and Climate, Veterinary Science, Film Making, Engineering, Culinary Arts, Outdoor Nebraska, and Unicameral Youth Legislature.

Other examples of program impact follow:
* An additional 1,200 K-12 youth were reached through the Leap into Careers, Making Cents of It, Discover Your Future, Real World Money, and Build Your Future programs and curriculum delivery statewide.
* A needs assessment done with 900 school counselors in early 2016 served as the basis for aligning Nebraska Extension's Career and College Readiness framework with the Nebraska Department of Education's Standards for Career Readiness and identify gaps in school programming.
* The Career Explorer website and app continues to be used and is currently under revision to include an additional 400 career options and expanded post-secondary educational options.
* Northeast Nebraska Career Day hosted nearly 1,000 high school sophomores from 36 northeast Nebraska high schools. Eighty-three percent of youth learned about a career they didn't know much about before.

Additional program impacts can be found at: http://extension.unl.edu/impact/

**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 |
|---|---|
| 2016 | 86414 |

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**
Nebraska ranks 12 in the United Health Foundation's America's Health Ranking for 2016. Obesity increased from 29.6% to 31.4% and diabetes had a minimal decrease from 9:5 to 8.8% 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:
- children in poverty decreased 18% from 18.3% to 15.0%.
- immunizations among children 19 to 35 months old decreased 8% from 80.2% to 73.8%.
- the percentage of the population without health insurance decreased 30% from 12.8% to 9.0%.
- preventable hospitalizations decreased 29% from 65.7 to 46.9 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 three years, smoking decreased 12% from 19.7% to 17.1% of adults.

**What has been done**
Our goal is to improve eating and activity patterns in youth and create environments that support healthier habits. In 2016, members of Nebraska's Food, Nutrition and Health team reached 38,500 youth and 24,900 adults (e.g., teachers, caregivers, parents) for a total of 63,400 Nebraskans through direct education and approximately 138,990 contacts through indirect education. Examples of programs included: 4-H Food Smart Families, Blender Bikes, iCook, Go

Nutrition and Physical Activity Self-Assessment for Child Care, Nutrition Education Program -- SNAP-Ed and EFNEP, School Enrichment Kits, Smarter Lunchroom Movement, Team Nutrition, and WeCook.

Engaging Learners: Deliver programming across the state through one- on-one education, group education, field days, health fairs, train-the- trainer methods, website, social media, and newsletters. Reaching 63,400 Nebraskans through collaborative learning, teamwork, and community involvement. Approximately 138,990 contacts were reached through indirect education such as website, social media, radio, newspaper, and online newsletters.

Partnerships: Collaborate with federal agencies, non-profit organizations, foundations, associations, other universities, and community coalitions and councils.

Resources: Utilize internal and external funds to support our programming. Example funding sources include: USDA (including SNAP- Ed and EFNEP), DHHS, Nebraska Team Nutrition, and National 4-H Council; $1.9 million in grant funds to help support healthy living programs.

**Results**

Nebraska Extension Healthy Lifestyle Programs for Children and Youth help youth participants improve the quality of their diets and increase physical activity levels through direct education as well as through healthier environments at home, school, and in the community. Encouraging these healthy behaviors and environments helps reduce food and health care costs by helping prevent chronic health conditions and providing safe environments throughout a person's life span. Watch the team video to learn more at https://vimeo.com/183727288.

WeCook: Fun with Food and Fitness

WeCook is a 12-week after-school program that reached 95 youth and their families. The goal of WeCook is to improve nutrition, physical activity levels, and food preparation skills for 4th and 5th graders. Families engaged in the program through newsletters and three family nights that allowed youth and families to interact and eat together. The program had the following results:

* Significant overall increase in daily physical activity shown by Fitbit activity tracker data.
* Significant increase in overall healthy plate photo scores.

"My mom used to let me just do little things, but now she lets me really help [in the kitchen]." -- WeCook youth participant

School Enrichment Kits (SEK)

Increased the quality of teacher nutrition educational instruction with 651 teachers in over 40 elementary schools. One respondent indicated that: "The kits are set up very well! They are teacher friendly and the students enjoy them very much!"

Growing Healthy Kids (GHK) reached 5,103 K-2 students and SNAP-Ed SEK reached 9,586 K-5 students in the classroom. Students in 3rd-5th grades had the following results:

* 60% increase in food safety knowledge.
* 38% increase in MyPlate knowledge.

School Wellness

Guided schools to support healthy eating and physical activity. Family nights help reinforce the importance of eating healthy and being active at home.

Partnered with Nebraska Department of Education/Team Nutrition to award $500 mini-grants to 89 Nebraska schools:

* Awarded 50 breakfast grants that reached over 19,636 students.
* Awarded 87 wellness grants that reached over 35,178 students.

Schools utilized their funds by offering grab n' go breakfasts, school wellness days, or family wellness nights to help increase health and wellness for students and their families. One school noted it would not have the funds to do these activities without the grant.

"We see a large change in school practices involving nutrition and physical activity." -- Mini-grant participant

**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. |