V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

☑ 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	25%		15%	
111	Conservation and Efficient Use of Water	14%		15%	
132	Weather and Climate	4%		5%	
133	Pollution Prevention and Mitigation	5%		11%	
135	Aquatic and Terrestrial Wildlife	5%		2%	
141	Air Resource Protection and Management	4%		0%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		13%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	7%		9%	
302	Nutrient Utilization in Animals	4%		9%	
303	Genetic Improvement of Animals	0%		1%	
305	Animal Physiological Processes	0%		8%	
307	Animal Management Systems	4%		4%	
403	Waste Disposal, Recycling, and Reuse	4%		3%	
405	Drainage and Irrigation Systems and Facilities	14%		1%	
605	Natural Resource and Environmental Economics	10%		4%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	37.0	0.0	68.0	0.0
Actual Paid Professional	46.0	0.0	27.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
832388	0	594112	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
989091	0	862350	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 underpin and will support future productivity and sustainability advances in agriculture.
• Collect, disseminate, and model climate change data essential for understanding the impact of climate on natural resource and agricultural systems.
• Conduct research and extension programs to develop/deliver new and improved crop and livestock integrated management programs that increase the potential for improved agricultural productivity in the face of environmental stress/climate variability.
• Conduct research and extension programs to develop/deliver new and improved information to help producers create sustainable crop and livestock production programs with improved environmental impacts.

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 District Boards of Directors) as their make decisions regarding natural resources and climate issues. The program will provide agency staff with the knowledge they need to carry out the agency responsibilities and mandates.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	18100	83900	13100	9300

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

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	10	138	148

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of Agricultural Research Division HATCH projects in climate change.

Year	Actual
2012	9

Output #2

Output Measure

- Number of workshops, continuing education programs, web-based curricula and field days/tours related to climate change.

Year	Actual
2012	370

Output #3

Output Measure

- Number of new extension publications and other education resources related to climate change.

Year	Actual
2012	10

Output #4

Output Measure

- Number of new products and decision tools developed and made available to clientele related to climate change.

Year	Actual
2012	6

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	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	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.
3	Nebraska will not exceed its allocation of water in the Republican River as allowed by the interstate compact with Kansas and Colorado. Nebraskan's allocation is 49% of the average annual water supply. The output measure will be the percent of the Republican River average annual water supply used by Nebraska.
4	Nebraska will have access to higher educated workforce trained in the new biology with skills applied to addressing critical science in climate change.

Outcome #1

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
2012	12500000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Twenty-four million acres of range and pasture resources are a primary source of feed for 1.88 million head of beef cows in Nebraska. Half of this rangeland is in the Nebraska Sandhills, a unique ecosystem that has transitioned from rich grasslands to dessert sand dunes multiple times during its history as a result of climate shifts. Future potential for climate change or increased climate variability will place this fragile ecosystem at risk. Drought conditions dramatically reduced forage production and grazing opportunities in 2012 and weaken the potential for regrowth in 2013. As of March 2013, hay reserves are at their lowest level ever. Even with normal rainfall, grass production is expected to be reduced by one-third in 2013. In addition, high price for feed grains and reduced production of ethanol and distiller's co-products have resulted in high feeding costs and risks of inadequate feed resources for maintaining Nebraska's cattle herd. Adapting to drought conditions and minimizing the loss of productivity of Nebraska range and pasture resources is essential to 20,000 businesses (beef cow operations) and to the rural infrastructure of much of Nebraska.

What has been done
UNL extension faculty in the beef spire has targeted drought as primary focus of educational programming in 2012. Our beef extension faculty have answered more than 780 individual clientele requests, authored or prepared over 114 written articles; 7 extension peer-reviewed publications; 93 radio or television presentations; 36 web pages; and 121 video or audio recordings for posting in social media or a website, and taught 68 workshops attended by 3221 total participants.

UNL Extension hosts many types of educational opportunities addressing integrated beef and

range/pasture issues. Our highest dosage educational experiences are the High Plains and Nebraska Ranch Practicums that focus on the integration of beef and range systems. These courses are the equivalent of a 4 hour undergraduate education experience taught on research and commercial ranches in the Sandhills and Panhandle of Nebraska. Medium dosage experience come in the form of one-day to multi-day regional conferences such as the Nebraska Grazing Conference, Gudmundsen Sandhills Laboratory Open House, Beef Production Conference, Range Beef Cow Symposium, Mid-Plains Beef Education Series, West Central Cattlemen Days, Ranching for Profitability regional programs, Cow/Calf College , UNL Barta Brothers Field Days, and the 4 State Beef Conference. In addition, there are many local educational opportunities for both youth and adults addressing range ecology, range and pasture management, fire recovery, pesticide safety, and grasshopper and prairie dog control, to name a few. The Beef Action Team assembled evaluation data from 800 participants in educational programs in 2012 which is summarized in the Global Food Security outcome.

Practically all educational programs targeting grazing and cow/calf production have addressed drought issues in some way in 2012 with drought dominating those educational programs delivered since June 2012. In addition, our partnership with Nebraska Public TV has been leveraged to provide timely information on many drought topics to all Nebraska ranchers. These programs have addressed a range and pasture drought related topics including strategies for reducing ranch feed demands, alkaline treatment of alternative crop residues, corn stalk residue use, grazing and baling of cornstalks for feed use, forage options for drought damaged crops, managing nitrates in feeding drought stressed crops, aflatoxin issues in drought stressed crops, feeding low test weight corn, insurance for drought risk management, economic implications of alternative herd downsizing options, considerations for renting of corns stalks for winter grazing, forage options for planting under irrigated conditions.

The web has been used extensively in 2012 for providing access to research based information on drought topics. The beef team has authored a wide range of written resources, webinars, and short videos that have been made accessible through UNL Extension Drought Resources (http://droughtresources.unl.edu), UNL Extension beef (http//beef.unl.edu), and YouTube (http://www.youtube.com/user/NUBeef).

Results

In 2012, 31 cow calf programs totaling 139 contact hours and reaching 601 participants representing 1.1 million head of cows, 1 million head of calves, and 240,000 replacement heifers were evaluated across the state. Most of these programs targeted drought related issues that related directly or indirectly to minimizing drought impact on range and pasture systems. Cow Calf workshop participants reported changes made were estimated to have an aggregated value of $12.5 million. Cow Calf evaluations indicated common changes by respondents addressed grazing management (64% of participants), nutrition (69%), pasture and range management (59%), and reproductive management (62%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
132	Weather and Climate
141	Air Resource Protection and Management
302	Nutrient Utilization in Animals

305	Animal Physiological Processes
307	Animal Management Systems
605	Natural Resource and Environmental Economics

Outcome #2

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
2012	208

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the USDA 2007 Farm and Ranch Irrigation Survey, Nebraska irrigates approximately 8.45 million acres with more than 6.70 million acre-feet of water annually. This represents a 11% increase in acres irrigated with 21% less water. This change is likely a result of both difference in rainfall patterns and concerted efforts promoting efficient irrigation water use. In 2004, state policy established a process for defining watersheds as a fully or over-appropriated. Part or all of eleven Natural Resource Districts are currently defined as fully or over-appropriated. Over-appropriated basins are required to reduce water use to 1997 levels. Discussion continues on defining additional areas of Nebraska as over or fully appropriated. State public policy continues to emerge and change annually on a variety of topics related to water use by irrigation.

What has been done
Irrigation Management: As a result of this past year?s drought, an educational emphasis has included sprinkler packages and uniformity, soil moisture monitoring and deficit irrigation. Additional Extension drought related programs are in the planning and development stages. Educational products release in 2012 include the Irrigation Management Home Study Course was released in 2012 on-line at http://marketplace.unl.edu/extension/irrigation.html . The intent of this Home Study Course is to increase the user?s awareness and understanding of irrigation management concepts. This in turn can help producers improve irrigation efficiency and reduce

deep percolation of nitrates. The target audience for this course includes: crop consultants, agency personnel, irrigated crop producers and others interested in improving their irrigation water management skills.

Panhandle irrigation program started with the Pumpkin Creek project and has transformed into a regional effort to conduct education of producers about surviving under deficit irrigation conditions. Educational efforts from that project have been expanded in cooperation with the three Natural Resource Districts with a focus on use of no-till for soil water conservation, timing of deficit irrigation, and dividing of limited water among different crops for maximum profitability. More irrigated wheat, dry beans and sunflowers (lower water using crops) are being planted as well as a return to alfalfa and sugar beets originally abandoned as a result of lower allocations.

NAWMDM: The Nebraska Agricultural Water Management Demonstration Network continues to demonstrate technologies to improve irrigation management and water use efficiency. The Crop Water App was developed at the request of Nebraska Agricultural Water Management Network (NAWMN) participants. This app provides an easy way to estimate soil water status based on Watermark sensors installed at depths of 1, 2, and 3 feet. With these sensor readings, the Crop Water app will estimate the water used as well as what is still available for Nebraska soils. You can also see historic sensor readings and graph the data. Download the app at: https://itunes.apple.com/us/app/crop-water/id557926049?mt=8 . 215 downloads have occurred to date.

Field Level ET: A statewide network of field level Evapotranspiration is posted on line for 339 producer sites and 60+ automatic High Plains Regional Climate Center ET data locations to provide producers with better estimates of crop water use (http://water.unl.edu/nawmn). An additional initiative, the NEBFLUX project, measures evapotranspiration and other plant and soil parameters for many different vegetation surface. It is the largest and most comprehensive network of its kind that is operated by a single laboratory in the United States. The project is providing extremely valuable data to state agencies (irrigation districts, NRDs, and DNR) for their designing, planning, and management of water resources and related infrastructures.

Monsanto Partnership: A partnership with Monsanto's Water Utilization Center has resulted in 33 joint sessions and tours taught by UNL Extension faculty and Monsanto staff on water utilization related topics reaching 1,050 adults and youth. This partnership is also producing greater exchange of UNL water related research with Monsanto staff and tour participants and implementation of 3 demonstrations and 3 research projects at the Monsanto Learning Center led

Results

Irrigation Management: In 2012, over 2,840 producers/consultants (representing 27.9 million acres of cropland) attended an educational program addressing irrigation issues. Previous follow up surveys have indicated that attendees have reduced water application by 2.1 inches per growing season. This reduced water application would save producers about $20 per acre in reduced pumping costs. The NAWMDN continues to expand from 15 farmer collaborators/partners in 2005 to over 800 in 2012. NAWMDN sites have provided much of the field documentation for water application reductions of 2.1 inches.

Data collected from 7 or 8 Natural Resource Districts on irrigation water pumped since 2005 has indicated a steady decline in water use from an average of 10.5 inches per year per acre to 6.6 inches per year per acre between 2005 and 2011. The drought of 2012 has dramatically changed that trend with an average pumping rate of 15.4 inches per acre per year.

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
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Nebraska will not exceed its allocation of water in the Republican River as allowed by the interstate compact with Kansas and Colorado. Nebraskan's allocation is 49% of the average annual water supply. The output measure will be the percent of the Republican River average annual water supply used by Nebraska.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Republican River Compact allocates the water supply of the Republican River, originally set at 11% to CO, 49% to NE and 40% to KS. Natural Resource Districts have developed plans that are contributing towards achieving the targeted allocation than includes retirement of irrigated acres, improvements in efficiency of irrigation water use, and limitations on irrigation development. Observed reductions in Nebraska water use (discussed later) are a result of extension education, public policy, and changes in rainfall patterns. Increases in 2012 due to drought have overshadowed water savings from recent years.

The measure for Nebraska?s consumptive water use in the Republican River basin are not available for public use for 2011 or 2012 due to litigation between Nebraska and Kansas.

What has been done

Conservation Practice Impact on Republican River: A field research analysis lead by UNL and Kansas State University has been completed of how installation of conservation terraces and small watershed reservoirs has impacted the stream flow in the Republican River.

Deficit Irrigation Project: A UNL project on deficit irrigation management when irrigation water supplies are limited has resulted in the development of a suite of spreadsheet models to optimize net return from irrigation water. The suite includes planning modules for single-season single-field, multiple-season single-field and multiple-season single field optimization. A UNL, Kansas State University, and Colorado State University faculty collaborated to develop a pilot deficit irrigation insurance procedure for the USDA Risk Management Agency. This is the initial deficit irrigation project in the US for RMA risk management programs and has been widely requested by clientele. RMA is currently working on implementation of the program. Following the drought, deficit irrigation education is beginning to gain traction. Project entitled Conserving Water through Informed Irrigation Management resulted in two daylong workshops with attendance of approximately 250 agricultural producers, consultants and service agency personnel.

Faculty member assisted in United States Supreme Court litigation as a consultant on apportionment of water in the Republican River Basin. Recent rulings from Special Master are generally favorable to Nebraska.

Results

Conservation Practice Impact on Republican River: A field research analysis suggests that terraces and small reservoirs have a) Increased evapotranspiration by approximately 36,000 acre-feet/year; b) Increased groundwater recharge by approximately 88,000 acre-feet/year; and c) Decreased stream flow by approximately 63,000 acre-feet/year. Results were presented to the State Engineers for Colorado, Kansas and Nebraska. Results will be considered in conjunctive water management of the Republican Basin.

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
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Nebraska will have access to higher educated workforce trained in the new biology with skills applied to addressing critical science in climate change.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To remain economically viable and environmentally compatible in a rapidly changing world, Nebraska farmers and related agribusiness representatives must have access to a highly educated and trained work force in order to take advantage of new information, incorporate new technologies, and adjust to changing economic, social, and environmental conditions.

What has been done

Results

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
135	Aquatic and Terrestrial Wildlife
141	Air Resource Protection and Management
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
307	Animal Management Systems
403	Waste Disposal, Recycling, and Reuse
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Natural disasters: Extreme drought conditions arrive in Nebraska during the spring of 2012 and persisted through the remainder of the year. The drought dramatically reduced forage produced, forced many dryland crops to be harvested as forage or hay, and created higher than normal levels of aflatoxin in corn. Weather service outlooks indicates that these conditions will persist into 2013. Federally subsidized crop insurance covered an estimated $1.5 billion in crop losses in Nebraska from the 2012 drought.

Economy: 2012 was a year of record setting crop prices for crops and solid year for farm income levels for crop producers. Because of the high grain and forage costs and lack of range and pasture grass production, livestock farmers experience unparalleled feed costs. For ranchers, their ability to secure sufficient forage has forced many to move cows into dry lot production space or significantly down size cow herds. The historical trend of downsizing the beef cow herd as well as cattle placement on feed continued in 2012 and is expected to accelerate in Nebraska in 2013 due to drought conditions. Despite the challenges faced by Nebraska cattle producers, U.S. poultry, egg and pork shipments exceeded previous highs for value and volume set in 2011. International beef sales dipped slightly in volume but broke the previous value record.

According to Bruce Johnson (published in Cornhusker Economics, March 20, 2013, http://agecon.unl.edu/c/document_library/get_file?uuid=7fcaa994-3cda-4041-85e2-9e701058cb1b&groupId=2369805&.pdf) "Despite an extreme drought and indicators of weaker agricultural earnings on the horizon, the markets for agricultural land in Nebraska have remained strong into early 2013. Preliminary findings from the 2013 University of Nebraska-Lincoln Nebraska Farm Real Estate Market Developments Survey show the state's all-land average value rose **25 percent** over the 12-month period ending February 1, 2013 (Figure 1 on next page and Table 1 on page 3). Following on the advances for each of the previous two years of 22 percent and 32 percent, respectively, the 2013 all-land value of $3,040 per acre is more than double the value of just three years previously, in early 2010."

Public policy and Government Regulations: Lack of a five-year farm bill was the primary public policy discussion in 2012. Disappearance of all USDA safety net for ranchers experiencing extreme drought is likely to speed downsizing by many ranches and loss of some ranch businesses in 2013.

Appropriation Changes: Steady state tax collection and soaring federal deficits has led to static state and declining federal budget support in 2012. Sequestration is likely to cause reductions within Extension programs possibly starting in 2013. However, the growth in

student enrollment has resulted in UNL adding 36 new positions in 2013, with approximately 6 having Extension responsibility.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

UNL Extension has divided into five spires of excellence with one specifically targeting climate change issues: 1) Water Climate and the Environment for Agriculture and 2) Water Climate and the Environment for Communities. The Action Team supporting each spire has identified one or more "Signature Outcomes" that first became active at the start of 2010. These "Signature Outcomes" continue to be delivered statewide in 2012 and establish methodologies for measuring statewide impact allowed capture of a significant part of our 2012 impact (see 'Making a Difference' in left hand column at http://extension.unl.edu). The faculty team supporting each spire is in the process of planning 2013 statewide delivery and evaluation procedures identified in the statewide action plans. These methods developed by our Action Teams provided our third statewide snapshots of educational program impacts including knowledge gain, intended and actual practice change, and likely conditional changes.

Key Items of Evaluation

Extension action team implementation plans, evaluation indicators and tools as well as 2012Impact reports are all found at http://www.extension.unl.edu/web/Extension/progfocus. A review of the specifics of these implantation and evaluation plans are found for the two most relevant action teams by going to http://www.extension.unl.edu/progfocus/actionteam-water-climate-and-environment