2016 South Dakota State University Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 06/02/2017

I. Report Overview

1. Executive Summary

The College of Agriculture & Biological Sciences at South Dakota State University is home to both SDSU Extension and the South Dakota Agricultural Experiment Station. The college is the largest at SDSU in terms of student enrollment, faculty/staff, and building space. Our college and SDSU's College of Education and Human Sciences work closely together to provide important programs in food science and research. Through many important partnerships, we are able to expand the boundaries of knowledge and enhance society.

SDSU Extension and the South Dakota Agricultural Experiment Station achieve their goals with researchers and state specialists located on the SDSU campus in Eastern South Dakota, eight regional centers operating across the state with field specialists, and six research field stations. Outreach is also achieved with three Federally Recognized Tribal Extension Program offices, and the West River Agricultural Center representing the Western part of South Dakota. 4-H Youth Development begins on campus with the South Dakota State 4-H Office and has 4-H field specialists in the regional centers and 4-H youth advisors in county owned offices. SDSU Extension's online teaching platform, iGrow, had 758,462 users during this reporting period. The primary user of iGrow is in South Dakota and the United States, but content is viewed in 208 countries around the world.

South Dakota State University uses the following Planned Programs in its Combined Research and Extension Plan of Work. The Planned Programs are based on the USDA Knowledge Area Classification System.

Natural Resources and Environment

The research activities in this program are primarily supported by our Department of Natural Resource Management. Hatch funded projects include but are not limited to research studies involving the consequences to soil from climate and land-use changes, risk analysis of water resources, environmental impacts on grasslands, climate variability, the impact on crops from Canada geese, watershed management, soil productivity, bioenergy, wildlife habitat, pollution prevention, and range management. Activities for SDSU Extension in this Planned Program involve grassland management, wildlife habitat development, no-till, corn and soybean nitrogen recommendations, soils management, and Concentrated Animal Feeding Operations.

Plants and Their Systems

The research activities in this program are primarily supported by our Department of Agronomy, Horticulture, and Plant Science, and our Department of Biology and Microbiology. Hatch funded projects include but are not limited to research studies in genetically modified corn, soil-borne plant pathogenic fungi and other crop pests and diseases, seed traits in grass species, nitrogen fixation, oat breeding, nodule development in soybeans, crop genetics and genomics, perennial grasses for bioenergy, grapevine mapping, improved alfalfa production, and best management practices for carinata, camelina, and flax. Activities for SDSU Extension in this Planned Program involve sorghum production, agronomy field schools, cover crops, alfalfa growth and production testing, utilization of field peas in South Dakota, Pesticide Applicator Training, Master Gardeners, and Integrated Pest Management.

Animals and Their Systems
The research activities in this program are primarily supported by our Department of Animal Science, Department of Dairy and Food Science, and our Department of Veterinary and Biomedical Sciences. Hatch funded projects include but are not limited to research studies to improve health and performance in dairy cattle, epidermis repair of food animals, pre-harvest management of beef cattle, co-product feeds for sheep, milk production management for dairy cattle, vaccines for viral diseases, and reproductive efficiency in cattle. Activities for SDSU Extension in this Planned Program involve the establishment of a partnership with Puerto Rico to recruit dairy workers, artificial insemination schools, the enhancement of a sustainable dairy community through a multistate collaboration, mineral nutrition in cattle, sheep production, animal welfare, heifer development, and the Calf Value Discovery program.

Agricultural, Natural Resource, and Biological Engineering
The research activities in this program are primarily supported by our Department of Agricultural and Biosystems Engineering. Hatch funded projects include activated carbon for water and blood purification, lignocellulosic based bio fuel, and the development of microorganisms to facilitate composting of plant materials. Activities for SDSU Extension in this Planned Program include land use and management practices to enhance water quality, feedlot development, calving barns, and lambing facility ventilation.

Food and Non-Food Products: Development, Processing, Quality, and Delivery
The research activities in this program are primarily supported by our Department of Agricultural and Biosystems Engineering, Department of Dairy and Food Science, and our Department of Biology and Microbiology. Hatch funded projects include but are not limited to emerging technologies in dairy manufacturing, conversion of lignocellulosic biomass into advanced liquid biofuels, the manufacture of new dairy food products, technologies for improving food safety, and the development of oilseed biofuels. Activities for SDSU Extension in this Planned Program include beef carcass fabrication, meat cookery, Meat Science Expo, and Barbeque Bootcamp.

Economics, Markets, and Policy
The research activities in this program are supported by our Department of Economics. Hatch funded projects include but are not limited to the economics of a bio-based industry, price behaviors of agricultural commodity derivatives, enhancing rural sustainability and quality of life, market studies for South Dakota produced beef, agricultural land market trends, and economic impacts of agricultural trade policies. Activities for SDSU Extension in this Planned Program involve ag land values, economics of conservation, risk and business management, commodity marketing, and costs of crop production.

Human Nutrition, Food Safety, and Human Health and Well-Being
The research activities in this program are supported by our partnership with the College of Education and Human Sciences. Hatch funded projects include research involving functionality traits of wheat dough, dietary bioactive food components, rural food environment, intervention to improve healthful behaviors in young adults, and dietary influences on obesity and chronic inflammation. Activities for SDSU Extension involve nutrition, healthy eating, physical activity, worksite wellness, food preservation, chronic diseases, community gardens, and gerontology.

Families, Youth, and Communities
The research activities in this program are supported by our partnership with College of Education and Human Sciences. The Hatch funded project is research that involves psychological and behavioral factors that impact the decision to save financially. Activities for SDSU Extension involve 4-H Youth Development, women in agriculture, estate and transition planning, family financial wellness, Native American events, rural sustainability, and building community capacity.

NOTABLE ACHIEVEMENTS

New Animal Influenza Virus - Influenza D
Discovered by SDSU researchers and distinct from influenza types A, B, and C. Influenza D is officially named by the executive committee of the International Committee of Taxonomy of Viruses.

Bio-char Activated Carbon in Liquid Phase
Besides water purification, bio-char derivate activated carbon was further applied into biomedical areas such as blood purification.

New Winter Wheat Cultivar
Oahe winter wheat cultivar with high yield and disease resistance qualities is released by South Dakota Ag Experiment Station. Oahe yields approximately 1.5 bushels more per acre than that of other SDSU varieties with a value of $4.5 per bushel. This equates to an advantage of $6.75 per acre.

Culturomics Method to Identify New Probiotic Strains from Healthy Gut Microbiota
Developed a new high-throughput culture method to identify beneficial bacteria from healthy microbiota. This method was applied to human, swine and poultry gut microbiota and several bacteria were identified that can suppress the growth of pathogens such as Clostridium difficile and Salmonella enterica. These bacteria are being further developed as alternatives to antibiotics to control drug resistant pathogens.

Oat Breeding
In this reporting period, 234 new unique cross combinations were made. Two new lines will potentially be released in 2017 and 2018 that are high yield and have disease resistant qualities. This could result in approximately 20 bushels more per acre than that of other SDSU varieties in areas where crown rust is prevalent and when no fungicide is applied. With a value of $2.50 per bushel, this equates to an advantage of $50 per acre.

Dough Baking Performance
Investigators discovered the correlation of dough's ability to stretch to the stability of the air cell walls. This simplifies the process for wheat breeders to identify which varieties have better baking potential. What once took 11 equations to calculate, now takes one, saving valuable time for wheat breeders.

Metabolic Syndrome - Risk Factors and Health Problems
Researchers continue to study gut microbiota by adding resistant starch type 4 (RS4) to a study group diet. All types of cholesterols were significantly decreased by improving the balance of bacteria in the gut. The nondigestible, chemically modified wheat fiber known as RS4 has the potential to reduce heart disease and Type 2 diabetes.

Manufacture of Dairy Based Ingredients
Researchers developed a production process for the manufacture of high protein dairy based ingredients. These ingredients are used in high protein products like protein bars, Greek yogurt, and process cheese. These new ingredients allow manufactures to produce products that meet consumer's desire for higher protein in their diets.

3rd Generation Biofuels
Even though productivity rates must be improved 100 times to achieve economic feasibility, researchers were able to increase the production of long chain hydrocarbons and alcohols by engineered cyanobacteria strains. Once the organisms produce the products fast enough, it will offset the capital and operating costs.

Peer-Reviewed Publications
Number of peer-reviewed publications for 2016:
South Dakota Ag Experiment Station - 151
SDSU Extension - 31

Native American Reservations
Approximately 29 educational events with 2067 participants took place directly on Native American Reservations.

Master Gardeners
SDSU Extension Master Gardeners contributed 16,387 hours to community horticulture education, a value of $332,492.

Wakaniza Ta'owozupi: Children's Garden
A community needs assessment resulted in a new community garden with 16 raised beds. More than 25 fruits, vegetables and herbs were planted, delivering fresh produce to this food desert. Both Wagner and Marty are small, rural South Dakota towns, largely populated with Native Americans.

4-H Memberships
South Dakota's two most populous counties, Minnehaha and Pennington, increased their 4-H membership more than 25 percent in 2016.

Calf Value Discovery Program
Nine cow-calf operations participated in consignment feed yard. One hundred sixty calves were vaccinated, dewormed, individually identified, and weighed. On average, total profit was $23.63 per animal. Data is useful to determine if management decisions are meeting goals.

AmeriCorps
SDSU Extension hosted 24 AmeriCorps members who contributed nearly 12,000 hours of service to community health, nutrition, and gardening programs. This represents a value of $241,000.

Annie's Project
Seventy-seven women participated in workshops designed to strengthen women's role in farming and ranching.

Gerontology Events
SDSU Extension participated in more than 40 presentations, workshops, and conferences dealing with aging and senior citizens.

Applicator Training Sessions
More than 3000 individuals were reached with commercial or private applicator training sessions.

Planned Programs Staff Effort Summary

This explains how much of each program is associated with each knowledge area.
South Dakota Agricultural Experiment Station (Hatch Research)
1. Natural Resources and Environment - 21%
2. Plants and Their Systems - 28%
3. Animals and Their Systems - 26%
4. Agricultural, Natural Resource and Biological Engineering - 2%
5. Food and Non-food Products, Development, Processing, Quality and Delivery - 8%
6. Economics and Market Policy - 8%
7. Human Nutrition, Food Safety, and Human Health and Well-Being - 6%
8. Families, Youth and Communities - 1%

SDSU Extension (Smith-Lever 3(b)(1) and (c))
1. Natural Resources and Environment - 6%
2. Plants and Their Systems - 11%
3. Animals and Their Systems - 15%
4. Agricultural, Natural Resource and Biological Engineering - 6%
5. Food and Non-food Products, Development, Processing, Quality and Delivery - 2%
6. Economics and Market Policy - 6%
7. Human Nutrition, Food Safety, and Human Health and Well-Being - 10%
8. Families, Youth and Communities - 44%

Total Actual Amount of professional FTEs/SYs for this State

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	87.2	0.0	176.7	0.0
Actual	115.0	0.0	181.8	0.0

II. Merit Review Process

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

- Internal University Panel
- External Non-University Panel
- Expert Peer Review

2. Brief Explanation

All Hatch projects are subjected to peer review prior to implementation and require independent peer reviews from two scientists. The department head or a departmental executive committee identifies peer reviewers. The department head and the AES Director serve as merit reviewers. Reviewers are required to comment on why the proposed research is needed, it's relevance to agriculture, the target audience, and how it compliments other research. Proposals for research grants that are funded by stakeholder groups are subjected to review by the stakeholders themselves and by college administrators. SDSU Extension administrators serve as the merit review team for the plan of work. Department heads and program directors conduct peer reviews of programs.

III. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals

Brief explanation.

Stakeholder participation is solicited from many sources and events, including agricultural check-off groups, commodity groups, funding organizations, governmental agencies, elected officials and boards, public events and meetings, news releases, and industry associations. SDSU Extension seeks and receives stakeholder participation through focused conversations with representative constituent groups reflective of outreach conducted via our Capstone Program Areas.

The capstone groups are:
Competitive Livestock Systems
Competitive Cropping Systems
Urban/Rural Interface
Food & Families
4-H Youth Development
Community Development
Native American

Stakeholders are highly encouraged to participate in and take an active interest in SDSU Extension by providing direction, suggestions, and positive ideas. We ask stakeholders to share visionary strategies that meet the SDSU Extension mission, particularly in the capstone area they are representing. Stakeholders are encouraged to provide feedback and ideas for collaboration and partnership, and to help SDSU Extension reach and serve all demographic populations of the state. At the county level, County Commissioners are asked to maintain a county advisory structure that engages the local 4-H Promotion and Expansion Committee in the advisory role. This advisory structure predominantly gives guidance to county funded budgets and local 4-H expansion efforts.

Example Sources of Stakeholder Input:

- South Dakota Soybean Research and Promotion Council
- South Dakota Beef Industry Council
- South Dakota Corn Utilization Council
- South Dakota Oilseeds Council
- South Dakota Pork Producers Council
- South Dakota Wheat Commission Council

- South Dakota Department of Education and Cultural Affairs
- South Dakota Department of Health
- South Dakota Department of Social Services
- South Dakota Department of Economic Development
- Department of Energy
- Environmental Protection Agency
- South Dakota Department of Agriculture
- Office of State Veterinarian
- South Dakota Game, Fish and Parks
- Natural Resources Conservation Service
- Bureau of Indian Affairs
- South Dakota Weed and Pest Commission
- South Dakota 4-H Leaders Association
- South Dakota Association of County Commissioners

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
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Brief explanation.

Individuals and groups are identified through networking, attending conferences, public meetings, the Internet, programming efforts, field tours, emails, and face-to-face arrangements.

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
- Survey of traditional Stakeholder groups
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups

Brief explanation.

Open dialogues are held with constituent groups to identify ways in which SDSU Extension can provide/develop outreach programs to meet identified needs to the targeted audience, whether that is a broad scale audience, e.g., ag producers, or specific sub-audiences such as beef producers. Capstone program areas will engage with their constituent groups on a quarterly to semi-annual basis. Written summaries of this feedback are produced and then shared on our web portal so they are accessible to staff and the general public. This feedback is then used to guide strategic program development within that program 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.

Administrators evaluate all input, requests and comments from stakeholders. SDSU Extension writes summaries of the discussions held by each capstone program with stakeholder and constituent groups. Program Directors share summaries specific to the capstone program area with department heads, faculty and specialists during program meetings. Stakeholder input is reviewed, considered and used as a basis to create SDSU Extension programs and AES research projects.

Brief Explanation of what you learned from your Stakeholders

Stakeholder input is very important to the Agricultural Experiment Station and to SDSU Extension. By soliciting input, we learn what the challenges are that they are facing and what they would like to see us do to address their challenges. We also learn what they believe the future of South Dakota looks like, what they see as opportunities, and what they think we can do to support those opportunities. Stakeholder input is reviewed, considered and used as a basis to create SDSU Extension programs and AES research projects.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
3699648	0	3151325	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1951644	0	2416253	0
Actual Matching	1951644	0	2416253	0
Actual All Other	0	0	0	0
Total Actual Expended	3903288	0	4832506	0

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Natural Resources and Environment

☑ 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
101	Appraisal of Soil Resources	10%		8%	
102	Soil, Plant, Water, Nutrient Relationships	31%		16%	
103	Management of Saline and Sodic Soils and Salinity	0%		4%	
104	Protect Soil from Harmful Effects of Natural Elements	1%		0%	
111	Conservation and Efficient Use of Water	4%		2%	
112	Watershed Protection and Management	0%		13%	
121	Management of Range Resources	14%		14%	
131	Alternative Uses of Land	4%		1%	
132	Weather and Climate	5%		8%	
133	Pollution Prevention and Mitigation	11%		0%	
134	Outdoor Recreation	2%		1%	
135	Aquatic and Terrestrial Wildlife	0%		22%	
136	Conservation of Biological Diversity	6%		9%	
141	Air Resource Protection and Management	12%		2%	
	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	4.4	0.0	48.5	0.0
Actual Paid	6.9	0.0	38.2	0.0
Actual Volunteer	1.4	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**
117099	0	507413	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
117099	0	507413	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

- Conducted Field and Lab Research
- Collaborated with Other States
- Partnered with South Dakota Game, Fish and Parks
- Partnered with the South Dakota Grassland Coalition
- Partnered with Business Organizations
- Collaborated with Non-profit Organizations
- Conducted Soil Health Workshops and Field Tours
- Conducted Training for Concentrated Animal Feeding Operations
- Partnered with the South Dakota Department of Environmental and Natural Resources
- Partnered with the Natural Resources Conservation Service

2. Brief description of the target audience

- Wildlife and Fisheries Managers
- Scientists
- Natural Resource Management Specialists
- State and Federal Agencies
- Environmentalists
- Outdoor Enthusiasts
- Farmers, Ranchers and Producers
- General Public
- Operators of Concentrated Animal Feeding Operations

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9054	1428035	2845	4224

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

Patent Applications Submitted

Year: 2016

Actual: 1

Patents listed

1. Small Stream Fish Ladders

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	1	27	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Natural Resources and Environment

Year	Actual
2016	21

Output #2

Output Measure

- Increase Rancher's Knowledge of Grazing Techniques and Grassland Management

Year	Actual
2016	1

Output #3

Output Measure

- Number of CAFOs Participants

Year	Actual
2016	41

Output #4

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	1

Output #5

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	30

Output #6

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	3

Output #7

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	62

Output #8

Output Measure

- Create Soil Health Learning Opportunities

Year	Actual
2016	25

Output #9

Output Measure

- Conduct Field Research to Determine the Effectiveness of the Canada Goose Damage Program

Year	Actual
2016	1

Output #10

Output Measure

- Research Climate Variability and Management Impacts on South Dakota Grasslands

Year	Actual
2016	1

Output #11

Output Measure

- Research Environmental Impacts on South Dakota Grasslands

Year	Actual
2016	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number of Natural Resources and Environment Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	28

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
South Dakota has a wide diversity of natural resources that depend on maintenance and good stewardship of the land. Too much grazing, urban sprawl, the creation of reservoirs, plant invasion, feedlot runoff, global warming, as well as the growing world economy all contribute to the degradation of our natural resources.

What has been done
Within the College of Agricultural and Biological Sciences, there are 28 Hatch projects that are categorized in the Planned Program of Natural Resources and Environment. The research activities in this program are primarily supported by our Department of Natural Resource Management. Projects include but are not limited to research studies involving the consequences to soil from climate and land-use changes, risk analysis of water resources, environmental impacts on grasslands, climate variability, the impact on crops from Canada geese, watershed management, soil productivity, bioenergy, wildlife habitat, pollution prevention, and range management.

Results
Through research, our Department of Natural Resource Management continues to build a scientific knowledge base to improve and understand the management of natural resources in South Dakota. Examples include:
Best management practices to protect soils, reduction of nitrates in drainage water, streamflow trends under climate variability, atmospheric nitrogen deposition on native prairie, anthraquinone effectiveness on soybean plants, prevention of nitrates through tile drainage, newly discovered insect species, construct elemental fingerprints of reservoir ecosystems, climate change effects on beaver-created wetlands, and biomass yield from switchgrass land. In addition, graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
103	Management of Saline and Sodic Soils and Salinity
104	Protect Soil from Harmful Effects of Natural Elements
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
121	Management of Range Resources
131	Alternative Uses of Land
132	Weather and Climate
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
141	Air Resource Protection and Management

Outcome #2

1. Outcome Measures

Number of Grazing School Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	62

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There are approximately 22 million acres of permanent pasture and rangeland in South Dakota. Rangeland is the lifeline of streams, ponds and lakes, and it is a source of wildlife habitat, recreation and scenic beauty. Rangeland is fragile and is profoundly impacted by management. The grazing lands of the Northern Plains are recognized as one of the most threatened ecosystems globally. As grazing lands are predominantly privately owned and managed, principally for livestock production, secure and profitable ranching is necessary to conserving this

vital resource.

What has been done
In cooperation with the South Dakota Grasslands Coalition and several other entities, SDSU Extension has partnered in grasslands management training to more than 490 student ranchers since 2003. Students participated in classroom presentations as well as hands-on field activities. The topics covered include plant identification, wildlife habitat development, prescribed burning, and ecological sites and soils.

Results
With its partners and the South Dakota Grazing School, SDSU Extension has helped producers of all ages become more skilled at reading their landscape. As new participants are reached, there is an increase in knowledge of many topics, including managing diversity on rangelands, pasture allocation, holistic management, soil health and infiltration, plant identification, and concepts of grazing. By better understanding the grassland conditions of their property, ranchers develop the skills needed to detect important information both beneficial and detrimental to their grasslands. The workshops and activities also allow producers to network, sparking creativity to help find solutions to their own challenges. By targeting many of the events to youth, SDSU Extension continues to help conserve South Dakota's fragile rangelands.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
121	Management of Range Resources

Outcome #3

1. Outcome Measures

Number of CAFOs Training Sessions

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Large-scale livestock producers, known as Concentrated Animal Feeding Operations (CAFOs), create potential water and air quality conflicts for rural communities in South Dakota. There is a need for the development of these operations, but environmental laws must be followed and good will with neighbors is imperative for the sustainability of large operations. Any CAFO that is applying for a General Permit must attend a CAFO Environmental Training Program.

What has been done
SDSU Extension, the South Dakota Department of Environment and Natural Resources (SD DENR), and the Natural Resources Conservation Service (USDA-NRCS) provide training two to three times a year for federal and state water pollution and control programs. The training sessions included topics on livestock production, manure management and land application practices. In addition, SDSU Extension Specialists discuss the management of nitrogen and phosphorus content of manure and air quality and odor. In FY2016 there were two training sessions.

Results
For the CAFO Environmental Training Programs provided, approximately 40% of the participants were required to be at the training sessions and the remaining 60% attended for the learning experience. Many of those attending for the learning experience represented county planning and zoning boards or offices. The session participants from livestock operations represented approximately 22,500 animals in the beef industry, 4,000 dairy cows, 60,000 pigs, 5 million laying hens and 3,000 sheep. Survey results showed a 21% to 32% increase in the overall understanding of the topics and an 83% overall satisfaction rate with the program. Over 63% of the participants who had not already adopted some of the practices demonstrated said they plan to adopt certain practices they learned.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

Outcome #4

1. Outcome Measures

Increase Soil Management Knowledge to Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016	703

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
With the increase in demand for global food production, it is essential to promote soil health. The same management practices that can improve soil health can also damage soil health if not done correctly. Producers need access to all available tools and information to remain environmentally sound, profitable, and sustainable.

What has been done
The primary research focus of the soil fertility management team has been recalibration of the corn nitrogen recommendations, nitrogen timing for wheat and corn, micronutrients for corn and soybeans, and evaluation of soil micro-biological amendments. Soybean phosphorus recommendation recalibration was finished and results showed no major changes to our current recommendations. Educational presentations at crop clinics and field days were made to increase the knowledge of many producers and agronomist.

Results
Producers and landowners gained knowledge that will not only encourage them, but will also challenge them to incorporate production practices that will help promote soil health. The increases in knowledge of fertilizers, pesticides, cover crops, and tillage practices help South Dakota's soil stay productive and profitable. The citizens of the state also benefit from better water quality and a better environment overall. Twelve articles were written and posted on the iGrow learning platform.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships

Outcome #5

1. Outcome Measures

Increase Knowledge to Control the Canada Goose Population

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016 1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Since the early 1900's, there has been a rapid decline in Giant Canada geese in South Dakota. Through restoration programs, Canada geese populations today have increased to the point that farmers register complaints that the geese are damaging crops, particularly soybeans. Research is needed to generate harvest parameters and survival rates estimates for the Canada goose population.

What has been done
The SDGFP Canada goose damage program allows landowners that file a complaint free access to abatement techniques. Little research has been conducted on flightless Canada geese that cause crop damage during the brooding and molting period. Currently, South Dakota AES is evaluating the effectiveness of several commercial chemical goose deterrents on soybeans in northeast South Dakota. New methods to reduce crop damage caused by Canada geese are being identified.

Results
The distance from water which geese would travel to eat soybeans after the areas near the wetland was treated with anthraquinone was evaluated. Upon completion of a student thesis, recommendations will be provided on the concentration of anthraquinone needed, the distance into the field water to apply, and effects of the chemical on soybean yield. Journal articles will be published from the thesis.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #6

1. Outcome Measures

Produce Knowledge to Implement a State-and-Transition Model for South Dakota Grasslands

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016 1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Climate variability complicates our ability to manage invasive plants and pests, rangeland quality, and livestock production. Changes in grazing pressure are triggers that lead to alterations in rangeland productivity and plant community structure. To better describe these changes, a State-and-Transition Model for South Dakota Grasslands is needed.

What has been done
Research is ongoing to determine the impacts of climate variability, increased nitrogen deposition, and management on resistance and resilience to plant community change and primary production of eastern South Dakota grasslands. Clipping, fire, and nitrogen treatments were applied 2016. Rainout shelters that simulated a drought with 50% reduction in rainfall was established on three ranch demonstration sites.

Results
During this reporting period, this study demonstrated that:
1-Clipping and fire have similar effects on manipulating prairie vegetation
2-Frequency of treatment shows exotic cool-season grass species are resilient to disturbance
3-sumulated increased nitrogen deposition appears to have minimal impact of community plant composition
The rainout shelters and spring defoliation treatments will be repeated in 2017.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources

Outcome #7

1. Outcome Measures

Improve the Understanding of the Environmental Implications on South Dakota Grasslands

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2016 1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
South Dakota is experiencing large-scale conversion of grassland to cropland. Increased land conversion combined with climate change will likely influence water availability and quality. Research is needed to quantify hydrologic and water quality impacts of land use and land cover change in the face of a changing climate in South Dakota.

What has been done
Research is being conducted through field monitoring, computer-based modeling, and established statistical techniques. The research includes trends and changes in streamflow, evaluation of water quantity and quality, and evaluation of the adoption of best management practices across different land use and land cover types in South Dakota. This includes two sets of subsurface drainage plots and five edge-of-field best management practices (four woodchip bioreactors and one phosphorous absorption bed).

Results
Research to date reveals that best management practices can be used to conserve water quality and soil quality in agricultural fields. The research also shows that subsurface tile drainage results in higher yield compared to undrained plots. Through this research, SDSU AES is getting a better understanding of South Dakota's grasslands and the implications of grassland depletion. The effectiveness of the field-based and watershed scale management strategies is being evaluated, which could mitigate nonpoint source pollution. The results of this research are being disseminated through conferences, peer-reviewed publications, outreach activities, and invited talks.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Natural Disasters (drought, weather extremes, etc.)

Brief Explanation

- Drought limited forage production during trials for white-tailed deer, making late summer plantings of forages problematic
- Analyses on Yellow Perch was unobtainable due to low sample size

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Concentrated Animal Feeding Operations Training Program
Post-workshop Surveys
35 of 41 Participant Responses
86% - Overall Participant Satisfaction with the Program

Understanding of the Topic before Program (average for two training session)
63% - Water Quality
56% - Permit
59% - Land Application
57% - Worksheets
59% - Conservation
53% - Nutrition
60% - Air Quality

Understanding of the Topic after Program
86% - Water Quality
83% - Permit
87% - Land Application
78% - Worksheets
89% - Conservation
85% - Nutrition
90% - Air Quality

Participants that Have Already Adopted Practices (average for two training sessions)
64% - Land Application
33% - Conservation
25% - Nutrition
13% - Air Quality

Percentage of Remaining Participants that Plan to Adopt Practices
83% - Land Application
77% - Conservation
69% - Nutrition
77% - Air Quality

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Plants and Their Systems

☑ 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	1%		33%	
202	Plant Genetic Resources	0%		7%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		15%	
204	Plant Product Quality and Utility (Preharvest)	5%		2%	
205	Plant Management Systems	20%		8%	
206	Basic Plant Biology	12%		7%	
211	Insects, Mites, and Other Arthropods Affecting Plants	23%		4%	
212	Pathogens and Nematodes Affecting Plants	9%		12%	
213	Weeds Affecting Plants	8%		1%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	0%		1%	
215	Biological Control of Pests Affecting Plants	0%		2%	
216	Integrated Pest Management Systems	22%		8%	
	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	10.5	0.0	51.1	0.0
Actual Paid	12.7	0.0	50.9	0.0
Actual Volunteer	8.0	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**
214681	0	676551	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
214681	0	676551	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

- Collaborated with the USDA Sunflower Research Unit
- Conducted Research on Soybean Nodule Development
- Collaborated with the South Dakota Bureau of Indian Affairs
- Developed Novel Wheat Cultivars
- Conducted Research on Economic Impacts of Fungal Diseases
- Developed Superior Sunflower Germplasms
- Bred Perennial Grasses and Legumes for Bioenergy Production
- Analyzed and Mapped Genes for Soybean Resistance of Aphids
- Developed New Multi-Purpose Oat Varieties
- Conducted Pesticide Applicator Training Sessions
- Conducted Integrated Pest Management Training Sessions
- Disseminated Research Results to the Public

2. Brief description of the target audience

- Oilseed and Other Specialty Crop Growers
- Research Community
- Soybean Growers
- Wheat Growers
- Corn Growers
- Biofuels Crop Industry
- Producers
- Graduate Students
- Private and Commercial Pesticide Applicators
- Master Gardeners

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	21107	1883073	2559	5166

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

Patent Applications Submitted

Year:	2016
Actual:	3

Patents listed
1. Natty (oat PVP)
2. Hayden (oat PVP)
3. Focus (wheat PVP)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	34	34

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Plants and Their Systems

Year	Actual
2016	28

Output #2

Output Measure

- Number of Pesticide Applicator Training Sessions
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of Master Gardener Training Sessions

Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Increase Pollinator and Pollinator Habitat Knowledge

Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	109

Output #6

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	200

Output #7

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	0

Output #8

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	51

Output #9

Output Measure

- Conduct Research for Improved Oilseed Production

Year	Actual
2016	1

Output #10

Output Measure

- Number of Integrated Pest Management Training Events Conducted

Year	Actual
2016	62

Output #11

Output Measure

- Conduct Research on Spring Wheat Cultivars

Year	Actual
2016	1

Output #12

Output Measure

- Conduct Research on Oat Cultivars

Year	Actual
2016	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of Plants and Their Systems Hatch Research Projects
2	Number of Pesticide Applicator Training Participants
3	Number of Participants Completing Master Gardener Training
4	Number of Integrated Pest Management Participants
5	Number of Citizen Science Volunteers
6	Increase Oilseed Crop Knowledge and Productivity and Profitability
7	Release Spring Wheat Cultivars
8	Develop and Release Oat Cultivars

Outcome #1

1. Outcome Measures

Number of Plants and Their Systems Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	35

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Crop diseases, insect pests, drought, changing climatic conditions, soil erosion, and fewer acres of land available for farming are all serious production constraints for all crops produced in South Dakota.

What has been done
Within the College of Agricultural and Biological Sciences, there are 35 Hatch projects that are categorized in the Planned Program of Plants and Their Systems. The research activities in this program are primarily supported by our Department of Agronomy, Horticulture, and Plant Science, and our Department of Biology and Microbiology. Projects include but are not limited to research studies in genetically modified corn, soil-borne plant pathogenic fungi and other crop pests and diseases, seed traits in grass species, nitrogen fixation, oat breeding, nodule development in soybeans, crop genetics and genomics, perennial grasses for bioenergy, grapevine mapping, improved alfalfa production, and best management practices for carinata, camelina, and flax.

Results
Through research, we continue to build a scientific knowledge base to improve and understand plant varieties, increased agricultural productivity, plant diseases, and the impacts of tillage on soil carbon levels. Examples include:
Prevention of pollination contamination in maize, engineered cyanobacteria to produce biofuels and commodity chemicals, new releases of oat and wheat cultivars, the development of high yield, pest resistant sunflower, oil extraction from oilseeds for biofuel production, soybean plants that produce more of its own nitrogen, and improve efforts to extend carbon assimilation of switchgrass. In addition, graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
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
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Number of Pesticide Applicator Training Participants

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of Participants Completing Master Gardener Training

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of Integrated Pest Management Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	4693

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the past decade, new invasive pests have been identified through the work of the SDSU Plant Diagnostic Lab, SDSU Extension Specialists, and the SDSU IPM program. And there is evidence that several common pests are becoming pesticide resistant. The proper identification of pests and the pest control measures used have a direct influence on the profitability of the farm operation. Without the improved knowledge of pest biology, unacceptable levels of pest damage can occur and pose risks to people, property and the environment.

What has been done
The South Dakota IPM Program is a collaborative effort between public and private agencies, multiple states, SDSU Extension, and SDSU Research. Approximately 4,693 people attended 62 training events in 2016, which included research farm tours, pesticide recertifications, workshops, field tours, and crop consultants updates. More than 8,200 people visited SDSU Extension's traveling displays. The SDIPM Program also worked with the SD Bureau of Indian Affairs on noxious weeds and the Crow Creek tribe after finding and confirming a new invasive crop weed.

Results
Participants of the South Dakota IPM Program have increased their knowledge of pest biology, disease identification, pesticide label interpretation, pesticide handling, and environmental factors. This leads to increased use of IPM practices and objective, science-based decision-making on reducing risks from pests and preventing unacceptable levels of pest damage in both agricultural and residential settings. The increased use of IPM practices results in better pest management decisions which address the economic aspects of pest management while posing the least possible risk to people, property, resources, and the environment. Through this program, professional agronomists receive the best up-to-date information available to advise their clientele. Producers are then able to make sound crop pest management decisions that are economically beneficial to their operations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #5

1. Outcome Measures

Number of Citizen Science Volunteers

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Increase Oilseed Crop Knowledge and Productivity and Profitability

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Alternative crops that can be grown in the dry regions of Western and Central South Dakota need to be evaluated for use in new cropping systems. Oilseed crops have been identified as suitable crops for these regions, but best management practices that are necessary for a sustainable crop production system remain undetermined. Additionally, biofuel feedstock crops grown in rotation with cereal crops have the potential to increase sustainability of cropping systems and reduce weed and disease problems.

What has been done
Experiments were conducted to determine the optimum planting dates and seeding rates for Camelina and Carinata in Western and Central South Dakota. In another study, winter wheat was planted in the fall on oilseeds stubble at two locations.

Results
Results show that both Camelina and Carinata should be planted as early as possible in the spring. A delay in the planting resulted in a yield reduction. Planting early is even more critical in drier environments that are typical of Western and Central South Dakota. Preliminary evidence indicates that Camelina and Carinata may have a good fit in cereal-based cropping systems in Western and Central South Dakota based on rotational trials of oilseed crops.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #7

1. Outcome Measures

Release Spring Wheat Cultivars

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
South Dakota's spring wheat producers desire cultivars that are adapted to a large geographic area, reliably produce high yields with little or no loss to disease or abiotic stress, and have acceptable test weight, protein levels, and other end-use qualities. Research in applied plant breeding methods is needed to develop and release cultivars that meet or exceed the expectations of South Dakota spring wheat producers.

What has been done
The SDSU spring wheat breeding and genetics program conducted applied and basic research focused on increasing grain yield and general agronomic performance potential of new spring wheat cultivars. This was carried out through utilizing South Dakota growing environments to select and advance promising experimental breeding populations and lines that possess increased yield potential and stability, elevated levels of disease and abiotic stress resistance, as well as increased end-use quality parameter values.

Results
Although no new cultivars were released in 2016, two experimental lines will be considered for release in 2017. An illustration of economic impact, which results from genetic gain, can be developed through comparing the performance of Boost and Surpass with the performance of one that was released previously. 'Briggs' was released by this program in 2002 and was very popular among growers for several years. Over all AYT locations during years 2014 through 2016, both Boost and Surpass produced approximately 5.2 more bushels of grain per acre than Briggs. At a market value of $5.00 per bushel, this equate to an advantage of $26.00 per acre that is available to growers that choose to plant the new cultivars as opposed to continually growing Briggs. Although both consistently produce more grain than Briggs, they were largely released for their elevated levels of disease resistance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
212	Pathogens and Nematodes Affecting Plants

Outcome #8

1. Outcome Measures

Develop and Release Oat Cultivars

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Oat is a low input crop which is used for forage, feed, food, and cover-crops. With the increased public awareness of oat health benefits, the food market for oat products is growing. To ensure that productive varieties meeting the needs of the multiple industries using oat are available to producers, it is essential to continue the genetic improvement of oat.

What has been done

Oat breeding activities were conducted to improve yield, yield stability, lodging resistance, test weight, disease resistance, and end-use quality. Approximately 234 new unique crosses combinations were made. Field testing was conducted on more than 550 unique populations and 1,200 breeding lines.

Results
Several SDSU experimental breeding lines have been discovered, two of which have the potential to be released to farmers in 2017 and 2018. Both have high yield potential, good test weight, and are moderately disease resistant. Both lines have the potential to increase farmer profits and reduce the use of fungicides.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Appropriations changes

Brief Explanation

- Drought caused the abandonment of a study of Carinata and Camelina plantings
- Failure to receive grant funding delayed proposed research of pathogen interactions
- Lack of external funding resulted in goals not being accomplished for a soil organic carbon study

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Boost and Surpass Wheat Cultivars
New wheat cultivars Boost and Surpass produced approximately 5.2 more bushels of grain per acre than the previously released cultivar, Briggs. At a market value of $5.00 per bushel, this equates to an advantage of $26.00 per acre.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Animals and Their Systems

☑ 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
301	Reproductive Performance of Animals	20%		9%	
302	Nutrient Utilization in Animals	23%		25%	
303	Genetic Improvement of Animals	6%		4%	
304	Animal Genome	2%		1%	
305	Animal Physiological Processes	0%		7%	
306	Environmental Stress in Animals	4%		0%	
307	Animal Management Systems	6%		7%	
308	Improved Animal Products (Before Harvest)	9%		6%	
311	Animal Diseases	4%		34%	
312	External Parasites and Pests of Animals	6%		0%	
313	Internal Parasites in Animals	3%		3%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	1%		0%	
315	Animal Welfare/Well-Being and Protection	16%		4%	
	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	11.3	0.0	27.5	0.0
Actual Paid	17.3	0.0	47.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
292746	0	628226	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
292746	0	628226	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

- Quantified Nutrient Supply for Lactating Cows
- Developed Vaccine Technologies
- Researched Methodologies to Increase Reproductive Performance in Animals
- Conducted Research that Leads to Muscle Growth Augmentation
- Determined the Effects of Co-product Based Lamb Finishing Diets
- Conducted Sheep Production Workshops
- Coordinated Value-Based Marketing System for Cow-calf Operations
- Developed Beef Production Workshops
- Conducted Ranch Visits
- Conducted Farm Tours

2. Brief description of the target audience

- Puerto Rico Department of Labor and Human Resources
- Veterinarians
- Dairy Producers
- Producers of Ethanol Co-products
- Cattle Producers
- Swine Producers
- Muscle Biologists
- Livestock Nutritionists
- Sheep Industry
- Cow-calf Producers
- General Public

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	14228	1388626	3891	3119

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

Patent Applications Submitted

Year:	2016
Actual:	2

Patents listed

1. Multiepitope fusion antigens and vaccines and their use in treatment of enterotoxigenic diarrhea
2. Orf virus based platform for vaccine delivery

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	24	31	55

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Animals and Their Systems

Year	Actual
2016	26

Output #2

Output Measure

- Publish and Disseminate Results of Nutritional Studies in Sheep Diets
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of Learning Activities for Sheep Producers or Consumers
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Demonstrate Value-Based Marketing to Cow-calf Producers

Year	Actual
2016	1

Output #5

Output Measure

- Create Learning Opportunities in the Beef Industry

Year	Actual
2016	18

Output #6

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	14

Output #7

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	186

Output #8

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	6

Output #9

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	111

Output #10

Output Measure

- Conduct Learning Events to Enhance the Dairy Industry

Year	Actual
2016	32

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number of Animals and Their Systems Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	31

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Production costs are the determining factor in livestock producer profitability. High feed costs, poor reproductive performance, and disease are primary concerns for producers and scientists.

What has been done
Within the College of Agricultural and Biological Sciences, there are 31 Hatch projects that are categorized in the Planned Program of Animals and Their Systems. The research activities in this program are primarily supported by our Department of Animal Science, Department of Dairy and Food Science, and our Department of Veterinary and Biomedical Sciences. Projects include but are not limited to research studies to improve health and performance in dairy cattle, epidermis repair of food animals, pre-harvest management of beef cattle, co-product feeds for sheep, milk production management for dairy cattle, vaccines for viral diseases, and reproductive efficiency in cattle.

Results
Through research, we continue to build a scientific knowledge base to improve and understand production efficiency and product enhancement, and to prevent and detect animal and human diseases. Examples include:
Early detection of subclinical diseases in dairy cows, enhance the innate immune system and speed repair of livestock wounds, growth-promoting implants in nursing calves, lamb finishing diets of soy hulls, DDG and treated corn stover, methods of controlling estrus and ovulation in cattle, heifer growth performance on reduced fat distillers dried grains, swine and bovine influenza viruses, and feeding strategies to optimize piglet quality and sow longevity. In addition, graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
304	Animal Genome
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
313	Internal Parasites in Animals
315	Animal Welfare/Well-Being and Protection

Outcome #2

1. **Outcome Measures**

Enable Further Research to Explore Diet Formulation Strategies for Feeding Ruminant Livestock

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of Individuals Participating in Sheep Production Learning Activities

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Number of Cow-calf Operations Participating in the Calf Value Discovery Program

2. **Associated Institution Types**

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The success of a cow-calf operation can come down to the marketing strategy employed by the producer. Retained ownership is a program that allows producers the opportunity to start with as few as five of their own calves and pool them with other calves to see how they perform in a feedlot. Retained ownership can provide the greatest opportunity to realize the true value of cattle, but it can also have increased economic risks.

What has been done
SDSU Extension coordinated the Calf Value Discovery Program, a retained ownership program in which 9 cow-calf operations participated with 160 calves. The calves were vaccinated, dewormed, individually identified, and weighed. They were consigned to a local feed yard where they were fed in a single pen, visually evaluated and sold in semi-load lots.

Results
The Calf Value Discover program provides feedback to producers on feeding performance and carcass characteristics of calves. The data provides a benchmark for comparison with cattle from other operations and it also provides useful guidelines for making selection and marketing decisions in the future. Several producers are using the data to influence their breeding program and some producers are using the data to market their calves for a higher price.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #5

1. Outcome Measures

Number of Individuals Participating in Beef Production Learning Activities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1406

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Beef producers face many risks in the industry, but there are many programs that can help them stay or become more competitive. An increased use of reproductive technologies results in genetically superior sires that result in calves with higher economic value. Managing heifer development is also critical for longevity and profitability.

What has been done
SDSU Extension specialists conducted numerous programs, presentations, and webinars on cattle reproduction and heifer development. Participants learned proper handling techniques of semen and artificial insemination, but the focus was on cowherd management including estrous synchronization, the pros and cons of new technology, cattle handling, nutrition interactions with reproduction, as well as herd health and genetic selection.

Results
The participants that attended the SDSU Extension sponsored artificial insemination schools gained a more in-depth knowledge of bovine reproduction and can now better manage their cowherds, which improves reproductive efficiency. They also now have the ability to artificially inseminate and to successfully set up an estrous synchronization protocol. Fifteen beef cattle veterinarians also attended a workshop and now have the ability to do liver biopsies to determine the mineral status of cattle. With more knowledge of nutrition, health, genetics, calving, and advanced reproductive technologies, beef producers will be better equipped to feed the growing world population.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

Outcome #6

1. Outcome Measures

Sustain and Enhance Growth in Dairy Production

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1514

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As identified by stakeholders, the present issues and needs of the dairy industry in this region are focused on three areas: 1) Market Assessment and Accessibility, 2) Social License to Grow - public perception, and 3) Dairy Development - availability of labor, succession planning and natural resources.

What has been done
With its many partners and collaborators, SDSU Extension was involved in numerous events to present research based information to the dairy industry and the general public. Farm tours, workshops, expos, demonstrations, and festivals are all part of the outreach efforts to share information and knowledge about the dairy industry. The events were carried out to provide unbiased information, increase profitability, optimize resource management, and enhance learning communities and build partnerships.

Results
Approximately 1,514 participants at 32 events increased their knowledge of the dairy industry. The topics included cattle handling, synchronization, genetics and genomics to increase milk and herd performance, managing employees, vaccinations, nutrient management, and best management processes. During farm tours, participants had the opportunity to see a newly constructed hoop barn and different types of calf housing and milk feeding units at four farm locations. Especially valuable at the farm tours was the participants ability to network with other producers and dairy industry personnel. An additional 1,700 people participated in a 3-day event that was an excellent opportunity for the public to learn about dairy production. The event included a tour of the SDSU Dairy Processing Plant, a Dairy Fest Carnival, and a tour of a modern dairy farm where participants were able to see what cows eat, how they are fed, and how they are milked. The efforts of SDSU Extension enhance the sustainability of the dairy industry in South Dakota and strengthen the rural economy through improved profitability.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems
315	Animal Welfare/Well-Being and Protection

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes
- Other (In-complete construction of the SDSU cow/calf research and education facility)

Brief Explanation

• The research infrastructure had not been completed at the facility, which prevented completion of the objective for research of fertility in growing bulls

• Availability of funding redirected a project's original focus on managing genotypes for best carcass outcomes

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Calf Value Discovery Program

On average, feeding costs were $340.49 per animal, while total costs were $472.17 per animal. This equates to a total cost of gain of $67/100 lb. When carcasses were sold on a grid marketing basis, price ranged from $1,300.47 to 2,221.63. When including the value of the feeder calf, there was a $692.33 per animal range in return from a loss of $393.40 to a profit of $298.93. However, on average total profit was $23.63 per animal.

Artificial Insemination School

80 Participants
100% Satisfaction with Training
100% Certified in Bovine Artificial Insemination
Size of cow herd
20% - < 50 head
18% - 50-100 head
25% - 100-200 head
37% - > 200 head
Type of Cattle Operation
25% - Seedstock
64%- Commercial
10%- Club Calf
1%- Dairy
Age of Participants
35%- < 25
57%- 25 - 50
8%- > 50
Length of time in the cattle business (in years)
23%- < 5years
33%- 5 - 10 years
23%- 10 - 20 years
21%- > 20 years
Also, participants identified which segments of the operation/cowherd expected to have the greatest impact on the success of AI programs:

Health
Nutrition
Timing of Insemination
Semen Quality
Synchronization Protocols
Technician Efficiency
Facilities
If advice was needed, participants were most likely to ask:
Veterinarian
SDSU Extension Field Specialist
Neighbor who has AI experience
Semen Dealer
Feed Salesman

Liver Biopsy Wet Lab Workshop
15 Participants

On a scale of 1 to 5, with 1 being poor and 5 being excellent, the presentations were rated as follows:
Determining Mineral Status-4.1
Interpretation of Results-4.1
Liver Biopsy Demonstration-5
Liver Biopsy Practice-5

As a result of participating in the workshop, here are some of the veterinarian's plans.
Advertise liver biopsy service
Do liver biopsy to determine copper levels in high sulfate areas
Emphasize importance of mineral analysis/testing
Take liver biopsies when I have a problem with reproduction and on sick calves.
Use liver biopsy to help determine mineral status of cattle and advise clients of proper supplementation

Of the 15 veterinarians who participated, 1/3 expected what they learned in the class to benefit their business greater than $1000, 1/3 said it would be greater than $500.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Agricultural, Natural Resource, and Biological Engineering

☑ 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	8%		0%	
111	Conservation and Efficient Use of Water	22%		0%	
401	Structures, Facilities, and General Purpose Farm Supplies	44%		10%	
402	Engineering Systems and Equipment	0%		10%	
403	Waste Disposal, Recycling, and Reuse	18%		66%	
404	Instrumentation and Control Systems	0%		14%	
405	Drainage and Irrigation Systems and Facilities	8%		0%	
	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	4.4	0.0	2.4	0.0
Actual Paid	6.9	0.0	3.6	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**
117099	0	48325	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
117099	0	48325	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

- Conducted Research to Produce to Produce Activated Carbon
- Conducted Research to Create New Sources of Biomass
- Conducted Research on Drainage and Water Management Design
- Conducted Water Management Conference

2. Brief description of the target audience

- Supercapacitor and Energy Industries
- Biofuel Industry
- Scientists
- Farmers
- Landowners
- Biomedical Industry

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	18093	1263961	4115	6948

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

Patent Applications Submitted

Year:	2016
Actual:	1

Patents listed
1. Methods and Systems of Detecting exocytosis of a target molecule from a population of cells

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	0	21	21

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Agricultural, Natural Resource, and Biological Engineering

Year	Actual
2016	2

Output #2

Output Measure

- Number of Subsurface Drainage Design and Water Management Workshops

Year	Actual
2016	1

Output #3

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	0

Output #4

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	15

Output #5

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	2

Output #6

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	4

Output #7

Output Measure

- Conduct Research on Carbon Materials and Biofuel Technologies
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of Agricultural, Natural Resource, and Biological Engineering Hatch Research Projects
2	Number of Subsurface Drainage Design and Water Management Workshop Participants
3	Enhance Understanding of Bio-renewable Graphene Production

Outcome #1

1. Outcome Measures

Number of Agricultural, Natural Resource, and Biological Engineering Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	3

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research in bioenergy technology is needed to enhance energy independence for the United States.

What has been done
Within the College of Agricultural and Biological Sciences, there are three Hatch projects that are categorized in the Planned Program of Agricultural, Natural Resource, and Biological Engineering. Projects include bio-char based activated carbon, lignocellulosic based bio fuel, and the development of microorganisms to facilitate composting of plant materials.

Results
Through research, our Department of Agricultural and Biosystems Engineering has continued to build its knowledge base that impacts new innovations and design systems in agriculture. Examples include:
Bio-char derived from activated carbon for water purification as well as applications into biomedical areas such as blood purification, the transformation of biochar into graphene to be used in supercapacitor energy storage devices, the development of biochemical or thermochemical pretreatment technologies that lead to the economical production of lignocellulosic based bio fuel, and to further characterize microbial samples that might have ability to both fix dinitrogen gas and break down some components of lignocellulose. In addition, graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies

402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
404	Instrumentation and Control Systems

Outcome #2

1. Outcome Measures

Number of Subsurface Drainage Design and Water Management Workshop Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	240

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In this reporting period, subsurface drainage design workshops were not conducted by SDSU; however, one water management conference was held. South Dakota?s lakes, streams, and freshwater ecosystems are susceptible to impairment from sources such as livestock grazing, feeding operations, crop production, and natural sources. To keep these water resources protected, science-based knowledge is necessary for its sustainability.

What has been done
The 2016 Eastern South Dakota Water Conference was held on the campus of South Dakota State University. The conference covered the latest strategies and research for water managers and water users in the Northern Great Plains. Presenters from South Dakota, North Dakota, Iowa, and Minnesota were in attendance. The theme for the 2016 conference was The Economics of Water Quality, where strategies and costs associated with water quality improvements were explored.

Results
Approximately 240 attendees from academia, agriculture interest groups, government agencies, and stakeholders gained knowledge and have a better understanding of the current focuses of concern of regional water resources. Participants increased their knowledge of nutrient reduction strategies, soil health, drainage water management, financial liabilities, and the fate and transport of E. coli in South Dakota waters. The knowledge gained will assist the participants when adapting proper land use practices aimed at improving water quality. It will also help government policy makers make informed decisions on water related issues.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
405	Drainage and Irrigation Systems and Facilities

Outcome #3

1. Outcome Measures

Enhance Understanding of Bio-renewable Graphene Production

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes

Brief Explanation

- Lack of funding prevented the research objective of the efficient use of water in the context of the variable rainfall

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food and Non-Food Products: Development, Processing, Quality, and Delivery

☑ 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
501	New and Improved Food Processing Technologies	0%		34%	
502	New and Improved Food Products	0%		16%	
503	Quality Maintenance in Storing and Marketing Food Products	20%		2%	
504	Home and Commercial Food Service	45%		0%	
511	New and Improved Non-Food Products and Processes	0%		48%	
703	Nutrition Education and Behavior	25%		0%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		0%	
	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	2.6	0.0	28.8	0.0
Actual Paid	2.3	0.0	14.5	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**
39033	0	193300	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
39033	0	193300	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

- Developed a Production Process for High Protein Dairy Based Ingredients
- Conducted Research to Enhance the US Dairy and Food Industry
- Conducted Research on Co-products of Corn and Soybeans
- Researched and Improved Biofuel Production Processes
- Conducted BBQ Bootcamp Workshops
- Partnered with South Dakota Beef Industry Council
- Partnered with South Dakota Pork Producer's Council

2. Brief description of the target audience

- US Dairy Industry
- Farmers
- Biofuels Industry
- Beef Science Community
- Beef Producers
- Food Businesses
- Consumers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1499	293367	1649	2289

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

Patent Applications Submitted

Year: 2016

Actual: 7

Patents listed

1. Production of Food Grade Distillers Dried Grains
2. Method and System for Manufacturing High Protein Dairy Products
3. Process for manufacture of milk permeate powders
4. Heat stable whey protein products and a process for the preparation of heat stable whey proteins
5. Process for the manufacture of mineral modified casein concentrate
6. Vacuum dough expansion system
7. Process for manufacture of milk permeate powders

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	2	21	23

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Food and Non-Food Products: Development, Processing, Quality, and Delivery

Year	Actual
2016	8

Output #2

Output Measure

- Developed a Strong Research Program to Enhance the US Dairy and Food Industry
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Extract and Analyze Oilseeds to Determine Biofuel Production Suitability

Year	Actual
2016	1

Output #4

Output Measure

- Number of BBQ Bootcamp Workshops

Year	Actual
2016	3

Output #5

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	12

Output #6

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	10

Output #7

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	20

Output #8

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	2

Output #9

Output Measure

- Conduct Research to Utilize Milk Components in Dairy Products

Year	Actual
2016	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number of Food and Non-Food Products: Development, Processing, Quality, and Delivery Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The challenge today of producing enough food, fiber and fuel for more than 9.5 billion people by 2050 is almost daunting, especially because it needs to be accomplished using less land, less water and less energy than is used today. Science driven technologies must be developed for this to be achieved in a sustainable manner.

What has been done
Within the College of Agricultural and Biological Sciences, there are 10 Hatch projects that are categorized in the Planned Program of Food and Non-Food Products: Development, Processing, Quality, and Delivery. The research activities in this program are primarily supported by our Department of Agricultural and Biosystems Engineering, Department of Dairy and Food Science, and our Department of Biology and Microbiology. Projects include but are not limited to emerging technologies in dairy manufacturing, plant compounds used to promote human and animal life, conversion of lignocellulosic biomass into advanced liquid biofuels, the manufacture of new dairy food products, technologies for improving food safety, and the development of oilseed biofuels.

Results
Through research, we continue to build a scientific knowledge base to improve and understand food and non-food products.
Examples include:
Controlling and optimizing dairy product properties, identifying medicinal uses of plants traditionally used by Native Americans, upgrading bio-oils into hydrocarbon biofuels, the manufacture of modified milk protein concentrates to be used as ingredients in food products, improved health and nutrition benefits from dairy products, and the development of an oilseed based biofuel industry ? biodiesel, bio-jet fuel, oil additives, and specialty lubricants that can help reduce our dependence on petroleum-based products. The biofuel industry also provides opportunities for agricultural diversification and rural sustainability in South Dakota. In addition,

graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Increase Knowledge of Structure-Function Relationships of Milk Proteins

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increase Knowledge for Obtaining Maximum Oil Yields

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The global demand for energy threatens the economic stability of nearly every country in the world. The United States needs to develop a sustainable source of bioenergy and bio-based products. Oilseed crops have enormous potential for use in a variety of biofuel markets. The biofuels industry provides opportunities for rural economic growth while reducing our dependence on foreign oil.

What has been done
A solvent-assisted extrusion process was carried out by simultaneous application of a laboratory scale single-screw extruder and plant-derived biodegradable solvent. The goal is to evaluate and compare the technical and economic feasibility of solvent extraction and cold press for efficiently extracting oils from various oilseeds for further conversion into bio jet fuels.

Results
The preliminary experimental results with camelina and carinata have revealed that increasing temperature and reducing the screw speed during extrusion usually increases the oil extraction yield by 15-20%. With the camelina and carinata seeds, it was discovered that soaking the seeds in green solvent prior to extrusion helped in reducing the residual oil content compared to those with no solvent. The conclusion is that the proposed method is green, clean and efficient.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #4

1. Outcome Measures

Number of BBQ Bootcamp Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	898

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In recent years, there has been a lot of negative information surrounding meat products. Many times this information is incorrect and misleading, leaving the consumer grasping for answers. Consumers have expressed the need for trusted science-based information to base their decisions upon. Consumers are also unsure of the proper way to handle and prepare meat to ensure both safety and quality.

What has been done
SDSU Extension, partnering with the South Dakota Beef Industry Council and South Dakota Pork

Producers Council conducted two full workshops in Sioux Falls and Renner and one modified program in Sioux Falls. The full workshops which had 98 participants, provided intensive, hands-on opportunities for consumers to enhance their understanding of meat cookery, barbequing, smoking, food safety, meat selection, and nutrition. The modified program, which had 800 participants, informed consumers of the nutrition and convenience of beef tri-tip.

Results
Participant evaluations indicate the workshops were very successful in educating consumers. According to participant evaluations the program greatly enhanced their understanding of cookery, selection, and nutritional content of common beef cuts as shown by the 2.3 unit increase in knowledge. Additionally, the participants viewed the program as extremely beneficial as they rated the program at 9.8 out of a possible 10 points.

4. Associated Knowledge Areas

KA Code	Knowledge Area
504	Home and Commercial Food Service
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Increase the Potential to Expand Dairy Production in the United States

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Protein is one of the most valuable components of milk. Today, the world demand for dairy protein exceeds the world supply. The U.S. dairy industry needs to identify and isolate valuable components of milk that can be converted into a variety of shelf stable products.

What has been done

Dried milk protein concentrate is produced from skim milk using a combination of processes such as ultrafiltration, evaporation or nanofiltration, and spray drying. It is well established that dried milk protein concentrate that contains 80% (MPC80) and greater protein content can lose solubility during storage. Partial replacement of calcium with sodium can improve the functionality and prevent loss of solubility during storage. This study subjected skim milk to an injection of carbon dioxide to improve functionality.

Results
The results indicate that carbon dioxide injection can be used to produce MPC80 with reduced calcium and mineral contents and optimal functionality. In addition, a patent application has also been filed for the production on mineral stabilized permeate using this process.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

BBQ Bootcamp
98 participants 14 returned surveys
Presentation
1 = not valuable; 10 = highly valuable
9.1 - Meat Selection and Retail Cuts
8.9 - Grilling, Smoking, Barbequing, Retail Selection
8.8 - Food Safety & Degrees of Doneness
8.9 - Spices, Rubs, & Marinades

Question
1 = absolutely not, 10 = absolutely; 1 = no knowledge, 10 = expert knowledge
9.6 - Did the speaker effectively explain the information?
5.8 - Knowledge level before program?
8.1 - Knowledge level after program?
9.8 - Was the program beneficial in helping understand food safety, handling, and proper cooking temperatures for meat?

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Economics, Markets, and Policy

☑ 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
601	Economics of Agricultural Production and Farm Management	37%		10%	
602	Business Management, Finance, and Taxation	33%		15%	
603	Market Economics	10%		23%	
604	Marketing and Distribution Practices	10%		19%	
605	Natural Resource and Environmental Economics	5%		11%	
607	Consumer Economics	5%		10%	
610	Domestic Policy Analysis	0%		12%	
	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	6.1	0.0	12.7	0.0
Actual Paid	6.9	0.0	14.5	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**
117099	0	193300	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
117099	0	193300	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

- Analyzed Supply Chain Management Strategies
- Analyzed Farm Real Estate Market Developments
- Analyzed Agricultural Commodity Prices
- Researched Trends and Financial Risks
- Developed Marketing Strategy Recommendations
- Conducted Estate and Transition Planning Conferences
- Partnered with the South Dakota Soybean Research and Promotion Council
- Conducted Ag Workshops

2. Brief description of the target audience

- Agricultural Commodity Groups
- Policy Makers
- Environmental Groups
- Farmers, Ranchers
- Producers
- Ag Land Owners
- Women in Agriculture
- Youth
- Agricultural Leaders

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	8489	359159	1147	1019

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	1	6	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Economics, Markets, and Policy

Year	Actual
2016	8

Output #2

Output Measure

- Conduct Studies to Identify Product Attributes and Willingness to Pay for Locally Produced Beef
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of Ag CEO Workshops
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	4

Output #5

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	33

Output #6

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	0

Output #7

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	27

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number of Economics, Markets, and Policy Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The economy is always changing and as new problems arise, research programs are needed to focus on the efficiency of crop and livestock sectors, sustainability of the food and fiber system, and rural development.

What has been done
Within the College of Agricultural and Biological Sciences, there are 10 Hatch projects that are categorized in the Planned Program of Economics, Markets, and Policy. The research activities in this program are supported by our Department of Economics. Hatch funded projects include but are not limited to the economics of a bio-based industry, price behaviors of agricultural commodity derivatives, enhancing rural sustainability and quality of life, market studies for South Dakota produced beef, and agricultural land market trends.

Results
Through research, our Department of Economics continues to build a scientific knowledge base to improve agricultural marketing and trade, farm and ranch management, and agricultural policies. Examples include:
The development of modeling and systems approaches to support sustainable biomass production, scientific and practical needs of flexible models for agricultural commodities, gender-based information for entrepreneurs in rural South Dakota, development of a marketing strategy for finished cattle, agricultural and international trade policy issues in the Northern Great Plains, commodity characteristic values of Hard Red Spring Wheat, and land markets and land management in South Dakota. In addition, graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
602	Business Management, Finance, and Taxation
603	Market Economics
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics
607	Consumer Economics
610	Domestic Policy Analysis

Outcome #2

1. **Outcome Measures**

Increased Understanding of Consumer Willingness to Pay for Locally Produced Beef

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Number of New Participants in the Ag CEO Program

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Human Nutrition, Food Safety, and Human Health and 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
701	Nutrient Composition of Food	0%		5%	
702	Requirements and Function of Nutrients and Other Food Components	0%		38%	
703	Nutrition Education and Behavior	34%		35%	
704	Nutrition and Hunger in the Population	21%		1%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		5%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		9%	
724	Healthy Lifestyle	45%		7%	
	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	11.3	0.0	5.0	0.0
Actual Paid	11.5	0.0	10.9	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**
195164	0	144975	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
195164	0	144975	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

- Collaborated with South Dakota Department of Health
- Conducted Self-Management of Chronic Disease Workshops
- Partnered in Worksite Wellnes Programs
- Conducted Workshops for the Aging and Senior Citizens
- Partnered with AmeriCorps Members
- Participated in the Implementation of Community Gardens in Native American Communities
- Conducted Research on Rural Food Environments
- Conducted Research on Obesity and Chronic Diseases
- Conducted Research on Dietary Micro-Nutrients
- Conducted Research on Dietary Bioactive Food Components
- Partnered in Community-based Wellness Projects
- Distributed Fact Sheets
- Developed Nutrition and Physical Activity Curriculum

2. Brief description of the target audience

- Business Worksites
- Nutrition and Food scientists
- Health Educators
- Native American Audiences
- Food Entrepreneurs
- Consumers of Food Products
- Local Schools
- Youth
- Senior Citizens

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5172	289487	3005	4944

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	3	20	21

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Human Nutrition, Food Safety, and Human Health and Well-Being

Year	Actual
2016	6

Output #2

Output Measure

- Number of Food Processing and Food Marketing Events

Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Number of Gerontology Events Presented

Year	Actual

2016	43

Output #4

Output Measure

- Number of Smart Choices Grocery Store Locations
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of Healthy Living Events that Created Learning Opportunities

Year	Actual
2016	4

Output #6

Output Measure

- Number of Food Safety Certification or Recertification Courses Presented
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	13

Output #8

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	125

Output #9

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	5

Output #10

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	2

Output #11

Output Measure

- Number of Garden Development or Enhancement Workshops and Webinars Conducted
  Not reporting on this Output for this Annual Report

Output #12

Output Measure

- Increase Quality of Life for Refugees in South Dakota
  Not reporting on this Output for this Annual Report

Output #13

Output Measure

- Create Horticulture Learning Opportunities

Year	Actual
2016	9

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number of Human Nutrition, Food Safety, and Human Health and Well-Being Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	8

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity is a major concern within the United States and specifically within South Dakota. It is related to poor nutrition, the lack of physical activity and increased sedentary behavior. Obesity has been associated with increased risk for many chronic diseases. Obesity research in rural populations is lacking. To improve individual's health, scientific discoveries need to be found and translated to practice.

What has been done
Within the College of Agricultural and Biological Sciences, there are eight Hatch projects that are categorized in the Planned Program of Human Nutrition, Food Safety, and Human Health and Well-Being. Research in this program is supported by our partnership with the College of Education and Human Sciences. Hatch funded projects include research involving functionality traits of wheat dough, dietary bioactive food components, rural food environment, intervention to improve healthful behaviors in young adults, and dietary influences on obesity and chronic inflammation.

Results
Through research, we continue to build a scientific knowledge base to understand and improve nutritional sciences.
Examples include:
Development of a vacuum dough expansion system for predicting bread loaf volume, implications that an increased intake of vitamin D and calcium may be beneficial for the prevention of obesity, understanding and preventing the underlying mechanisms of chronic diseases, innovative approaches to increase healthy nutrition and physical activity in rural populations, behaviors that support healthful lifestyles in young adults, and determining the impact of dietary components. In addition, graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
724	Healthy Lifestyle

Outcome #2

1. Outcome Measures

Number of Food Processing and Food Marketing Participants

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increase Knowledge of Aging Issues to Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The vast majority of South Dakotans identify remaining in the home or community as a high priority during retirement and older age. It is difficult to attain this without deliberate anticipation of future needs and efforts to mitigate barriers to independence. Reliable, evidence-based information is critical for South Dakotans to make informed decisions about their future. Adults that are prepared to meet challenges have the potential to reduce the strain that is placed on

public resources.

What has been done
SDSU Extension completed a process evaluation of the intergenerational technology program, allowing for solution implementation and testing in fiscal year 2017. Two hundred fifty people across the state participated in the pilot of the technology supported vendor fair. Evaluation indicated a success event, with event well received, even by adults receiving information through a technology solution (teleconference). As a result of SDSU Extension's outreach efforts, South Dakotans have more knowledge about aging, older adults, age-friendly communities, brain health, ageism, and planning for the future.

Results
Aging Gracefully Expo (AGE) was piloted in 4 communities in 2016. The event was well received by attendees and vendors, creating the opportunity for program refinement and evaluation. Evaluation results confirmed the need for consumer education around topics related to aging and caregiving. Attendees reported a low level of familiarity with common services available to older adults.

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #4

1. Outcome Measures

Number of Smart Choices Grocery Store Participants

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number of Participants Involved in Healthy Living Learning Opportunities

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	331

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Obesity, poor nutritional habits, low levels of physical activity, and chronic diseases adversely affect the quality of life in South Dakota. The problem is not limited to adults; children in South Dakota have higher than average risks for obesity and diabetes. Risk behaviors for all ages need to be modified to prevent or greatly reduce the risk for developing health related problems and diseases.

What has been done
Through partnerships, SDSU Extension is involved in many programs that help create or maintain healthy living environments. Wellness coalitions have been established by several rural communities to address community health and wellness. South Dakotans with chronic diseases learn to live with their conditions through self-management workshops conducted across the state. Children in a book reading curriculum learn to make positive choices about healthy eating and physical activity. A worksite wellness program helps businesses target the health and well-being of the South Dakota workplace.

Results
By working with many organizations, including healthcare providers, health professionals, advisory groups, and the South Dakota Department of Health, SDSU Extension impacts thousands of individuals. Wellness coalitions have implemented interventions that promote access to fruits and vegetables, increase healthy eating behaviors, and to provide access to physical activity opportunities. One project in a minority community resulted in school policy changes that will improve academic performance by allowing time for physical activity, healthy eating education, and allowing more time for children to eat breakfast. Businesses and employees across the state that participate in worksite wellness could see significant benefits with morale, productivity, energy level, as well as a decrease in stress and illness. All these actions are empowering community members to live healthy lifestyles.

4. Associated Knowledge Areas

KA Code	Knowledge Area
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
724	Healthy Lifestyle

Outcome #6

1. **Outcome Measures**

Number of Participants that Completed Food Safety Certification or Recertification Food Safety Courses

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Number of Community or School Gardens Receiving Assistance with Development or Enhancement

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Number of New Roots for New Americans Program Participants

Not Reporting on this Outcome Measure

Outcome #9

1. **Outcome Measures**

Increase Horticulture Knowledge to Participants

2. **Associated Institution Types**

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	355

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

South Dakotans rank among the poorest in daily vegetable consumption. Native American children in South Dakota have higher than average risk for obesity and diabetes. Rural populations often have limited options for grocery stores, instead relying on convenience stores and fast food choices which are more readily available. Growing one's own food requires skill and knowledge. Receiving horticultural advice increases those skills and knowledge.

What has been done
In partnership with Master Gardeners, AmeriCorps members and other collaborators, SDSU Extension participated in the implementation of numerous community gardens and taught gardening classes to youth and adults. Many of the gardens served as classrooms for nutrition. Other topics taught included soil testing, cultivation, irrigation, harvesting, and diagnosing plant diseases.

Results
The community gardens, seven of which were in Native American communities, not only produced fresh, nutritious fruits and vegetables, but also provided physical activity and generated a source of pride in the communities. The fresh produce, as well as the nutritional information learned in the gardening classes is a great start in reducing healthcare costs that are associated with obesity and diabetes.

4. Associated Knowledge Areas

KA Code	Knowledge Area
704	Nutrition and Hunger in the Population

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Families, Youth and Communities

☑ 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
205	Plant Management Systems	4%		0%	
704	Nutrition and Hunger in the Population	19%		0%	
801	Individual and Family Resource Management	13%		100%	
802	Human Development and Family Well-Being	11%		0%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	14%		0%	
806	Youth Development	39%		0%	
	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	36.6	0.0	0.7	0.0
Actual Paid	50.6	0.0	1.8	0.0
Actual Volunteer	8.6	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**
858723	0	24163	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
858723	0	24163	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

- Conducted Workshops for Annie's Project
- Conducted Beginning Farmer and Rancher Symposium
- Conducted Research that Examines Financial Savings Behavior
- Built Community Capacity
- Conducted Activities on Native American Reservations
- Conducted Leadership Workshops
- Conducted Character Education Program Training
- Conducted Community Strategic Planning Workshops

2. Brief description of the target audience

- Women in Agriculture
- Low to Moderate Income Families
- Rural Communities
- Entrepreneurs
- Youth
- Teenagers
- Native Americans
- Local Schools
- Youth Program Leaders

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	12825	518565	37954	57614

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	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Families, Youth and Communities

Year	Actual
2016	1

Output #2

Output Measure

- Number of Teens Trained in the Teens as Teachers Program

Year	Actual
2016	58

Output #3

Output Measure

- Number of High School Students Selected as 4-H Hometown Hero Representatives
  Not reporting on this Output for this Annual Report

Output #4

Output Measure

- Number of Communities Hosting the Ripple Effect Mapping
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Number of Events Conducted on Native American Reservations

Year	Actual
2016	29

Output #6

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2016	81

Output #7

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual
2016	193

Output #8

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2016	9

Output #9

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2016	3

Output #10

Output Measure

- Conduct Activities that Build Community Capacity

Year	Actual
2016	10

Output #11

Output Measure

- Create Financial Literacy Learning Opportunities
  Not reporting on this Output for this Annual Report

Output #12

Output Measure

- Conduct Character Education Programs and Activities

Year	Actual
2016	1

Output #13

Output Measure

- Create Learning Opportunities for Youth

Year	Actual
2016	14

Output #14

Output Measure

- Create Resource Management Learning Opportunities

Year	Actual
2016	7

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. Outcome Measures

Number of Families, Youth and Communities Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There are concerns that the savings rate of American households, especially low and moderate income households is inadequate, leaving families extremely vulnerable to economic setbacks. Additionally, research indicates that there is a link between financial security and over-all health. Unhealthy families are not able to fully socially and economically contribute to their communities.

What has been done
Within the College of Agricultural and Biological Sciences, there is one Hatch project that is categorized in the Planned Program of Families, Youth and Communities. The research activity in this program is supported by our partnership with College of Education and Human Sciences. The Hatch funded project is research that involves psychological and behavioral factors that impact the decision to save financially.

Results
Through research, we continue to build a scientific knowledge base to improve and understand the sociological factors associated with personal finance. A cross-cultural survey on college student financial management behavior was created and administered at South Dakota State University and in Korea. Compared to Korean college students, the SDSU students had more debt and financial stress, but were more optimistic about their economic future. A manuscript for the survey findings is being prepared for peer-reviewed publication.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

Outcome #2

1. Outcome Measures

Number of Students Taught by Teens as Teachers

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	200

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Teenage students need skills and knowledge to mature into good citizens, effective parents, productive workers, and life-long learners. Building upon character and youth development through experience will help young people develop qualities of confidence, leadership, initiative, motivation, reliability, and a positive attitude.

What has been done
Teens as Teachers is a 4-H program that gives teenage youth the opportunity to develop life skills by assuming a teacher role and teaching younger students or adults 50 or older. The teen teachers build their own lessons and programs based on their interests in the subject matter of bullying, robotics and engineering, aerospace and rocketry, or nutrition in fruits and vegetables.

Results
The teen participants of the Teens as Teachers program sum up the success of the program by reporting that they are:
1) more comfortable speaking and teaching in front of children
2) more flexible working as a team - experienced sacrifice and negotiation
3) more self-confident working with adults
4) more responsible - for themselves and for others
5) more prepared for a career - either in education or exploring other options

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. Outcome Measures

Number of Elementary Students Impacted by 4-H Hometown Hero Representatives

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #4

1. Outcome Measures

Ripple Effect Mapping Participants

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number of Participants Involved in Native American Reservation Events

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	2067

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There are many agriculture related issues that need to be addressed on South Dakota's reservations. Access to nutritious food is limited. The knowledge of traditional foods is getting lost. Many tribal land owners own fractionated allotments of land and lack the knowledge of how to lease the land or obtain funding. The rangelands are sometimes overgrazed or the plants are exposed to pesticide overspray. There is a huge interest for agriculture programs on the reservations.

What has been done
Through its partnerships, SDSU Extension has Federally Recognized Tribal Extension Program offices at Cheyenne River, Pine Ridge and Rosebud Reservations. Nutrition Assistants, 4-H Program Advisors, and Field Specialists all provide leadership and outreach activities to the Native American communities. In collaboration with its partners, SDSU Extension conducted horticulture and livestock programs, gardening workshops, food preparation and preservation classes, workshops that focus on wild and native foods and herbs, and participated in farmer?s markets.

Results
Native American Reservation communities in South Dakota benefit greatly from SDSU Extension's efforts. Members of all ages gained knowledge in many areas. Wellness coalitions have helped in the implementation of interventions that promote healthy behaviors. New community gardens are providing access to fresh fruits and vegetables that were otherwise not available. Four hundred chokecherry trees were planted on Cheyenne River Reservation, helping to build a stronger more sustainable community. On Pine Ridge Reservation, a program focuses on three traditional native foods, wild strawberry, wild raspberry, and wild mint. On Rosebud Reservation, youth learned about wild edible plants and medicinal plants, as well as livestock usage. Another program on Rosebud Reservation offers training in financial literacy, workforce

development and capacity building for entrepreneurs and organizations. All of these programs contribute to self-sufficiency, sustainability, and empowering tribal members.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
704	Nutrition and Hunger in the Population
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

Outcome #6

1. Outcome Measures

Enhance Rural Community Sustainability in South Dakota

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As organizations and groups in South Dakota prepare for their future, the need for planning is apparent. But rural communities often lack the resources to address important issues. By helping to build community capacity and equipping them with the tools they need, rural communities can increase their chance of sustainability.

What has been done
During this reporting period, the SDSU Extension Community Development team focused their efforts on Organizational Strategic Planning for communities across the state. A strategic planning workshop was developed that identifies a group's strengths and how to build on those strengths for the future. SDSU Extension staff prepared personalized presentations that they facilitate at the workshops. After the facilitator gathers information at the workshop, a strategic plan is written that takes the organization through a process that leads to an action plan. The organization is then responsible for carrying out the plan.

Results

The SDSU Extension Community Development team assisted 10 unique groups with strategic planning for the future. Having committed to serving the public in some way, all of the organizations now have a well-defined plan that shows the public that they are following a definitive direction that links back to their mission. By following the road map that they created, they are now able to give the public a concrete image of what they are striving for as a team and offers a form of accountability to the people they serve. All 10 groups are working on the strategies outlined in their plan.

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #7

1. Outcome Measures

Increase Family and Personal Financial Literacy to Participants

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Build Good Character in South Dakota's Youth

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	669

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Today's youth are continually exposed to negative role models and high risk behaviors, leading to higher incidences of bad decision making. With 82% of South Dakota's parents working outside of

the home it is essential for educators and practitioners to assist youth in learning how to make better decisions.

What has been done
SDSU Extension 4-H provided 669 South Dakota youth in 4th, 7th and 9th grades an opportunity to learn about maxims and how they apply to their lives. By reflecting on maxims, the students learn to clarify their own values to become a better person of character. Applying the maxim to their own lives helps the students to be better at decision making. The contest also stretches the student's minds to develop critical thinking and reading and writing skills.

Results
Through the Quotes to Live By Essay Contest, students are making better decisions and becoming better people of character. The teachers reported positive outcomes of the essays through the following quotes about their students.
... the students grew as individuals when they reflected on their own life ...
... I came into a better understanding of their values and what they believe in ...
... a wonderful opportunity for my son and I to explore and discuss wise and enduring truths ...
... it brought positives and hopes ...
... I opened up too and shared moments of my life ...
... the students were amazed at the number of quotes that were available or that they could relate to ...

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #9

1. Outcome Measures

Develop Life Skills for Youth

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	304

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Less than 1% of the population is now directly involved in farming. In addition, it is extremely difficult for the Millennial Generation to get started in farming due to the lack of capital resources. And there is a shortage of qualified workers in certain areas of the agriculture industry. We must reach rural and urban youth to educate them about the possibilities of careers in agriculture.

What has been done
With many partners, SDSU Extension reached South Dakota youth through many programs and events. Dairy Fest is a three-day celebration where dairy farmers, processors, and industry leaders bring the community together for the public to learn about dairy production. Dairy Cattle Judging schools were conducted throughout South Dakota that teach youth important life skills. A farm tour taught 1st graders how dairy cows produce milk and how that milk is processed into dairy products. Youth and adult volunteers were exposed to dairy production and dairy manufacturing areas in the STEM curriculum.

Results
As our youth continue to learn about agriculture and life skills, many will be the next generation that will keep the agriculture industry in South Dakota sustainable. Our youth gained valuable life skills in animal evaluation, quality standards, processed dairy products, profitable production practices, confidence and resilience building, decision making, and public speaking. It is extremely important that we reach out to the young to prevent a shortage of people working in the agriculture industry. More than 304 youth participated in 14 educational events.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #10

1. Outcome Measures

Increase Individual and Family Quality of Life

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	497

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The prosperity of farm and ranch families is critical to the sustainability of rural South Dakota. Whether it is young producers, women in agriculture, or the older generation of farmers and ranchers - they all need business and management resources to help keep their operations thriving.

What has been done
SDSU hosted a Beginning Farmer and Rancher Symposium for students from SDSU and Lake Area Technical Institute. The symposium featured bankers, estate planning attorneys, and other professionals that provided information to the students that can be shared with members of the family operation. Workshops for Annie's Project were conducted that also addressed estate planning as well as insurance, wills, finances and business plans. Annie's Project is a national program designed to strengthen women's role in farming and ranching.

Results
The students that attended the symposium are much better prepared to return to their family operations. Most of them reported that they learned new communication skills and that their families needed more communication among the members. The knowledge they gained will help them create transition plans that increase the chances of the family operation continuing. The 77 women that attended the Annie's Project workshops increased their knowledge and expertise to become better business partners. The program also provided an environment for women to network with other women in agriculture.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Economy

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Annie's Project

- Women are making themselves more knowledgeable partners in the farm and ranch businesses plus a better owner/operator
- The most important thing women learned was information about estate planning and insurance.
- Increased knowledge and expertise of women to become better business partners.
- Increased understanding of marketing, estate planning, financial and production

systems

- Medium Term Impacts:
  - 42% of participants improved family communications a great deal, while 37% improved communication with business partners a great deal
  - 40% stated that they are doing a significantly better job of tracking finances as a result of participating in Annie's Project, 33% a fair amount
  - 85% of the participants implemented strategies to help create balance in their lives, 37% a great deal, 47% a fair amount
  - 58% have completed a financial analysis of their business
  - 26% have evaluated their estate plans at least a little, with 14% evaluating them a great deal, 37% a fair amount
  - 33% have used what they learned about farm programs (FSA and NRCS) a great deal, 26% a fair amount and 29% a little
  - 38% of the participants have used the livestock nutrition information a great deal, 31% a fair amount
  - 90% have accomplished a goal or at least a portion of a personal goal
  - 88% have accomplished a goal or at least a portion of a business goal
  - 79% are using the marketing plans they created
  - Due to the training on family business meetings, 49% have held family meetings since participating in Annie's Project
  - Because of Annie's Project 25% have implemented a new marketing strategy and 30% have adopted a production or business strategy to improve unit cost of production.

Participants would like continued interaction as Annie's Project Alumni, whether through an Annie's Project Alumni Conference (22%), face-to-face training sessions (21%), webinars (18%) or social networking groups (17%).

Key Items of Evaluation

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.