2016 University of Nevada Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 08/02/2017

I. Report Overview

1. Executive Summary

University of Nevada Cooperative Extension (referred to as "Nevada Extension" throughout this report) contributed to the National Institute for Food and Agriculture's (NIFA) programmatic goals of Global Food Security and Hunger; Climate Change and Natural Resources; Childhood Obesity, Nutrition and Health; Community and Economic Development and Human and Family Development. In 2016 Nevada Extension's efforts (which supported 12.4 FTE, with $1,205,024) reached 105,550 adults and 29,054 youth directly and 1,186,987 adults and 176,530 youth indirectly. Nevada Extension produced 44 peer reviewed publications, including fact sheets, curricula and peer-reviewed journal articles. Drought and continued lag in economic recovery were factors affecting programming success.

Global Food Security and Hunger efforts included programming in five knowledge areas-(121(18% of the total federal funding applied to this theme), 205(45%), 211(2%), 213(11%), and 216(16%), supporting 2.7 FTE with $154,752. In 2016 Nevada Extension's efforts reached 63,210 adults and 2,776 youth directly and 11,245 adults and 245 youth indirectly. Efforts were distributed among nine (9) programs: 1) Bioplastic Pots Research, 2) Grow Your Own, Nevada! 3) Master Gardeners 4) Commercial Landscape Horticulture 5) Urban Integrated Pest Management 6) Integrated Pest Management, IR-4 and Pesticide Safety Education 7) Weed Management Program / Weed Extravaganza 8) Alternative Crop Production in Nevada and 9) Corn/Soybean Production in Nevada, all of which were designed to meet stakeholder and audience needs. Nevada Extension evaluated each program and demonstrated knowledge gains among audiences. Efforts led to 17 publications, including fact sheets and peer-reviewed journal articles.

Climate Change and Natural Resources efforts included programming in seven knowledge areas-111(7% of the total federal funding applied to this theme), 112(18%), 121(21%), 132(14%), 136(11%), 307(4%), and 723(7%) supporting 2.9 FTE with $136,929. In 2016 Nevada Extension's efforts reached 15,471 adults and 3,813 youth directly and 1,270,536 adults and 129,018 youth indirectly. Efforts were distributed among the following 15 programs: 1) Integrated Riparian Management / Creeks and Communities 2) Range Management School 3) Nevada Youth Range Camp 4) Sage Grouse Conservation Facilitation 5) Nevada Naturalist 6) Rangeland Resources and Range Management Education 7) Eagles and Agriculture 8) Water for the Seasons 9) Living With Fire 10) Nevada Wildfire Awareness Month 11) Drought-Resiliency of Small Town Groundwater Supplies 12) Flash Flood Education and Citizen Group 13) Awareness Week and Media Campaign for Nevada Flood Hazards 14) Carson River Watershed and Floodplain Education and 15) Climate Change Education Workshop and Partnership. Nevada Extension evaluated each program and demonstrated knowledge gains among audiences. Efforts led to 9 publications, including fact sheets and peer-reviewed journal articles.

Childhood Obesity, Nutrition and Health efforts included programming in two knowledge areas-703(73% of the total federal funding applied to this theme), and 704 (27%) supporting 0.9 FTE with $141,514. In 2016 Nevada Extension's efforts reached 9096 adults and 12,533 youth directly. Efforts were distributed among two programs: 1)Veggies for Kids and Veggies for Seniors and 2) Little Books and Little Cooks. Nevada Extension evaluated each program and demonstrated knowledge gains among audiences. Efforts led to 3 publications, including fact sheets and peer-reviewed journal articles.

Community and Economic Development efforts included programming in three knowledge areas-601(52% of the total federal funding applied to this theme), 605 (14%) and 608 (34%) supporting 3.0 FTE with $494,549. In 2016 Nevada Extension's efforts reached 12567 adults and 930 youth directly and 46,547 indirectly. Efforts were distributed among the following nine programs: 1) Lincoln County Workforce Development 2) Agriculture Innovation Forum Series 3) Leadership Douglas County 4) Moapa River Indian Reservation Strategic Housing Plan 5) Nevada Volunteers: State Plan of Service 6) Herds & Harvest 7) Nevada Risk Management Education 8) Stronger Economies Together (SET) and University Center for Economic Development Extension Programs and 9) Native Waters on Arid Lands. Efforts led to 10 publications, including fact sheets and peer-reviewed journal articles.

Human and Family Development efforts included programming in four knowledge areas-801(15% of the total federal funding applied to this theme), 802(14%), 805(34%) and 806(25%), supporting 2.9 FTE with $277,280. In 2016 Nevada Extension's efforts reached 5206 adults and 9002 youth directly and 720 adults and 46,547 youth indirectly. Efforts were distributed among the following eight programs: 1) Keeping Kids Safe: Recognizing, Reporting and Responding to Child Maltreatment Training in Elko County 2) Heart and Shield: Rural Domestic Violence Prevention Program 3) Yerington Paiute Tribe Maternal, Infant, and Early Childhood Home Visiting Program 4) 4-H Youth and Families with Promise Mentoring Program - Churchill County 5) Project MAGIC 6) GEAR-UP (Gaining Early Awareness and Readiness for Undergraduate Programs) Extension Components: a) Research and Evaluation, and b) STEM Education for Rural Nevada Adolescents 7) Striving Readers and 8) Family Storyteller. Efforts led to 6 publications, including fact sheets and peer-reviewed journal articles.

The Nevada Agricultural Experiment Station (NAES) contribution to the NIFA 2016 Annual Report will focus on select programs that reflect the unique benefits to a diversity of clientele and stakeholders in Nevada.

NAES and the College of Agriculture, Biotechnology, and Natural Resources are focused on improving the quality of life for all Nevadans through education, research and outreach that support the agricultural enterprise; foster community health and well-being; promote natural resource sustainability; and stimulate statewide economic development.

This past year, the NAES formula-funds grant program included Hatch, Multi-State, McIntyre-Stennis, and Animal Health funding opportunities, driven by peer and stakeholder review, and embraces the Federal-State partnership directed by the Hatch Act and subsequent Farm Bill provisions.

One of NAES's state performance metrics is external funds leveraged per dollar of formula funds funding. In 2015-2016, $2.75M in federal-state appropriations were leveraged by faculty to generate $4.4M in external fund expenditures. Our faculty published 101 peer-review journal articles, trained 112 graduate and 199 undergraduate students, gave over 240 presentations, conducted 30 workshops, and developed 18 new mathematical models or scientific protocols.

Some of this year's research highlights include:

Global Food Security and Hunger

- Developed a protocol to measure root hydraulics in tomato plants.
- Constructed a new molecular based tool that reduces teff height, which is helpful in reducing plant lodging. A common problem in windy areas like Northern Nevada.
- An experimental vineyard was planted in Southern Nevada using native grape root stock.

• New evidence suggest that beef cattle digestion can be improved through the use of chia seed and/or glycerin supplements.
• To improve pollen tube development under stressful conditions, two genes were identified that when manipulated increase pollen fitness by up to 9-fold.
• Biological markers underling the differential wound healing and storage capacities of two potato cultivars was identified and incorporated into the breeding program at Michigan State University.
• Establishment of a breeding colony of hornworms for use in pest management through a better understanding of feeding behavior hormones.
• A new protein that directly limits cellulose biosynthesis in plants has been identified and mutants have been designed.
• Vaccine trials on bovine foothill abortion has inoculated over 10,500 cows across Nevada and California.

Climate Change, Natural Resource Management and Environmental Science

• Methods developed for detecting atmospheric mercury and lead have now been integrated into EPA's air quality management models.
• Working with hydrologists at the USDA-NRCS, the NAES team has begun developing a procedure to include soil moisture observations in streamflow forecasting.
• Genetics on Bighorn Sheep that were translocated continues, with over 700 new samples analyzed and submitted to UNR's genomic library.
• In assessing Sage Grouse, new methods of estimating survival, spatial data on vegetation, and broods sizes were incorporated into GIS models.
• The only fully instrumented watershed-scale studying pinyon-juniper continues monitoring plant community responses to remove of PJ (7^{th} year).
• Results were obtained on mowing fuel breaks in sagebrush rangelands.
• Molecular advancements were made in determining how Bark Beetles produce attractant pheromones and deal with digestion of toxic resin produced by pine trees.

Sustainable Energy

• Research into Prickly Pear Cactus as a biofuels resource in arid climates continues. A major breakthrough came in the increase of lipid content through genetic modification.
• Camelina work also continues, with traits like succulence being engineered into lab plants that show proof of concept.
• A transgenic line of Camelina was developed, producing an oil more suitable for biofuel mass production
• Our line of vitamin B1 enhanced Camelina is proving to be well suited for growing in high salinity soils
• Our labs have identified three high-oil mutant plant lines of Camelina
• Varietal trials have revealed a line of Camelina that has lower levels of mucilage, important in processing
• Biofuels production from Gumweed research has found better methods of extracting the oil that might be usable in jet fuel.

Childhood Obesity, Nutrition, and Health

• A new line of research has begun at UNR looking at the epigenetics of cardiovascular diseases and diet.
• Work looking into the effects of grape seed extract supplements on humans has pinpointed the mechanism that inhibits insulin resistance, have found the process in which intestinal bile leads to lower triglyceride levels, and have determined that the extract helps as a lipid-lowering therapy by decreasing

metabolic formation of fat.

• Our team of scientists working on relapsing fever, a tick-borne disease, continue to educate the homeowners and state/county public health officials on prevalence and detection of hot zones in the eastern Sierra Mountains

Food Safety

• Our food safety scientist has developed protocols that reduce salmonella contamination by 90% in ground beef and chicken.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	33.0	{No Data Entered}	18.5	{No Data Entered}
Actual	12.4	0.0	25.9	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

Nevada Extension's merit review process

Nevada Extension's merit review process comprises multiple steps. Annually Nevada Extension tenure-track faculty prepare a Role Statement detailing their teaching, research, and service activities for the coming calendar year. Extension faculty review their individual Role Statements with their Area Director and/or Department Chair who ensures the quality and relevance of planned programming efforts effectively address formally identified program goals. Both the Area Director and the Nevada Extension Dean/Director review and approve the plan.

Annually, Nevada Extension faculty evaluate their peers' teaching, research and service activities to assess overall performance and program quality. Peers consider the results of formal needs assessments, programs developed in response, and the substance of documented outcomes and impacts in rating peer performance and providing narrative feedback. Area Directors also conduct an annual review of faculty performance and provide narrative feedback. Area Directors then meet individually with faculty to discuss the documented results of the peer review and Area Director's review. The Nevada Extension Dean/Director also reviews and signs off on the evaluation documents.

Finally, some Nevada Extension efforts are a part of the Multi-state Review Committee (MRC) process and are documented, reviewed and approved by the sponsoring regional association. These committees are responsible for the review, evaluation, and recommendation of western multistate programs which may involve research, academic programs, extension, and/or international programs.

NAES's merit review process
Scientific peer review drives the initial selection of research projects that comprise the NAES research portfolio. NAES administration solicits applications from NAES/CABNR scientists in a general call for proposals that identifies annual priority areas. Faculty submit proposals through an in-house, web-based content management system.

Based upon research priority area, expert peer reviewers are assigned by NAES administration to rate proposals based upon merit in the field of research, PI's qualifications, projected outcomes, degree of multi-disciplinary activity, and budget feasibility. The NAES administration concurrently sends proposals to its external advisory board panel representing stakeholder interests for evaluation and ranking based upon their constituents' inputs.

Tabulated results, comments, recommendations and proposals are then sent to the PI's home department administration for internal review. Departmental recommendations are then send forward to NAES administration. All findings are then compiled by NAES administration and final decisions are made based on the rankings, comments and stakeholder input.

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
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Other (Use of social media; conduct field days at our University field stations)

Brief explanation.

Use of local newspapers and radio, through public-service announcements, encourage stakeholders to participate in public meetings and listening sessions. In 2016, Nevada Extension also used paid advertisements in the Edible Tahoe-Reno quarterly to specifically target the increasing number of small and urban farm operators, Community Supported Agriculture organizations, and their clientele. Extension and Experiment Station had booths and representatives at the annual meetings of the Nevada Cattlemens' Association, the Nevada Association of Counties, the Nevada Small Farm Conference and the Governor's Conference on Agriculture. Extension organized an information/outreach tour of Northern Nevada in the Cattlemens' Update. Extension engaged the Latino Coalition in Clark County as members of a search committee to better understand and meet needs specific to the Las Vegas metropolitan area. Extension and Experiment Station participated on the Nevada Governor's Council on Food Security, the Northern Nevada Food Bank and the Nevada Governor's Drought Forum. Extension and Experiment Station also participated as members of the planning committee for the Nevada Water Resources Association annual conference, the Nevada Governor's Conference on Agriculture and the annual Small Farm Conference hosted by Western Nevada Community College.

Faculty target traditional and non-traditional stakeholders through email and postal mail invitations to

participate in public meetings, focus groups, and individual interviews. Poster announcements are placed in public places frequented by traditional and non-traditional audiences.

Formal needs assessments serve as another means for contacting stakeholders. Faculty continually assess stakeholders' perceived program priorities in order to efficiently allocate resources and to identify and develop partnerships for program implementation and delivery.

Primary data-collection methods include postal mail and internet surveys, focus groups, and individual interviews. Results of Cooperative Extension community needs assessments are published and made available to other university faculty and the broader public via the Nevada Extension website (www.unce.unr.edu/publications/assessments).

Frequently, faculty develop partnerships with a variety of stakeholder groups as part of program planning, development, and implementation. These community and organizational partnerships provide an ongoing venue for receiving stakeholder input and feedback for the life of a program.

An advisory board has been established to counsel Experiment Station in matters of research, resident instruction and outreach. The board's qualifications cover a wide spectrum of interest, from local ranchers to federal agencies. Board members are asked to conduct focus groups based upon their home district to ascertain viewpoints and ideas on the needs and deficiencies of their local region.

Nevada Extension will reform an Advisory Committee in 2017. The committee has been inactive since 2014 due to several factors. Committee members will represent a diverse cross-section of stakeholders with programmatic interests from the two Nevada Extension areas (north and south) and rural and urban communities, including minorities. Two Advisory Committee members are representatives on the Council of Agricultural Research, Extension, and Teaching (CARET) and regularly communicate with Nevada's Congressional delegation as well as USDA/NIFA administrators.

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

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys
- Other (Informal discussions with key stakeholders)

Brief explanation.

Nevada Agricultural Experiment Station currently has a broadly based advisory board committee that meet and provides input multiple times per year. In addition, we have faculty members that schedule and coordinate meetings throughout the state with the purpose of obtaining direct input to the NAES research portfolio.

Our partnership with Nevada Extension provides assistance and access to stakeholders through joint efforts like the annual Cattlemen's Update - a program designed to bring the researcher to the

rancher - and Beginning Famers and Rancher events held throughout the state. With NAES administration abiding by an "open door policy", informal discussions with key stakeholders provides important input into our research programs and resident instruction. Comments are also received through our website.

Stakeholder input is routinely used to identify emerging issues, to direct and redirect Extension programs and also in the hiring process. Stakeholders include local elected and appointed officials, community leaders, citizens, underserved groups and individuals, university leadership, university academic departments, and Nevada Extension faculty and staff. Therefore, the areas to be emphasized reflect the views of a broad set of stakeholders. Stakeholder input is used to determine the necessary qualifications of those hired and/or to create new positions, as new funding becomes available. Stakeholders also participate in Nevada Extension faculty searches. Additionally, stakeholder input is used to help establish program priorities and to acquire necessary funding.

Use of local newspapers and radio, through public-service announcements, encourage stakeholders to participate in public meetings and listening sessions. In 2015, Nevada Extension also used radio announcements and paid advertisements in trade and limited distribution newsletters to reach small scale producers. Extension also sponsored booths and representatives at the annual meetings of the Nevada Cattlemens' Association, the Nevada Association of Counties, the Nevada Small Farm Conference and the Governor's Conference on Agriculture. Extension organized an information/outreach tour of Northern Nevada in the Cattlemens' Update. Extension participated on the Nevada Governor's Council on Food Security, the Northern Nevada Food Bank and the Nevada Governor's Drought Forum. Extension also participated as a member of the planning committee for the Nevada Governor's Conference on Agriculture and the annual Small Farm Conference hosted by Western Nevada Community College.

Faculty target traditional and non-traditional stakeholders through email and postal mail invitations to participate in public meetings, focus groups, and individual interviews. Poster announcements are placed in public places frequented by traditional and non-traditional audiences. Formal needs assessments serve as another means for contacting stakeholders. Faculty continually assess stakeholders' perceived program priorities in order to efficiently allocate resources and to identify and develop partnerships for program implementation and delivery.

Primary data-collection methods include postal mail and internet surveys, focus groups, and individual interviews. Results of Cooperative Extension community needs assessments are published and made available to other university faculty and the broader public via the Nevada Extension website (www.unce.unr.edu/publications/assessments).

Frequently, faculty develop partnerships with stakeholder groups as part of program planning, development, and implementation. These community and organizational partnerships provide an ongoing venue for receiving stakeholder input and feedback for the life of a program. Nevada Extension is reforming an Advisory Committee to replace the current membership, which has been inactive since 2014. Committee members will bring programmatic oversight and support to each of Nevada Cooperative Extension's programmatic themes. Two Advisory Committee members also serve as representatives on the Council of Agricultural Research, Extension, and Teaching (CARET) and regularly communicate with Nevada's Congressional delegation as well as USDA/NIFA administrators

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

Brief explanation.

In development and strategic planning of Experiment Station research programs and priorities, input was collected primarily through meetings with stakeholder groups and individuals including concerned citizens, ranchers, agricultural organizations, natural resources professionals and managers, state and federal agency representatives, food industry representatives, and Nevada Extension administrators, specialists and educators.

Experiment Station will also hold several other public events during the year to gather information from stakeholders. Whenever it is feasible, efforts are made to coordinate relevant activities with extension to avoid duplication.

Research project participants obtained direct and indirect stakeholder input through varied avenues. Projects with social science components frequently used questionnaires and surveys. Stakeholder input to some basic science and some applied projects occurred in the form of reviewer inputs to proposals, and from questions, comments and discussions at regional, national and international conferences. Stakeholder input for other projects was collected through comments and questions at workshops and topical meetings for end users.

Nevada Extension meets frequently with stakeholders throughout the state. This includes formal presentations to county commissions, the Nevada Association of Counties and community groups. It also includes participation as a member in state panels and commissions and executive boards, such as the Nevada Sagebrush Ecosystem Council, the Nevada Governor's Drought Forum, the Columbia Spotted Frog Conservation Consortium, the Nevada Governor's Council on Food Security, and the Food Bank of Northern Nevada. County-based Extension Educators and Nevada Extension administrators meet formally and informally with county commissioners, and public service groups, such as Rotary Clubs. Extension Educators also conduct formal needs assessments involving survey instruments.

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
- Other (Strategic planning)

Brief explanation.

The Nevada Agricultural Experiment Station collected information from stakeholders to adjust issue areas that are influencing Experiment Station's future direction. These stakeholder priorities also directly influenced applied research activity, while influencing which departments or areas of expertise get hiring priority. Successful strategic hires enable us to meet existing needs and at the same time reposition for those on the horizon. Our stakeholders help us see into the future to identify those emerging issues. For example, in the past year the decision to hire faculty focused on agronomy and plant biochemistry. Input from Nevada's cattle and sheep industry reinforced this decision, and the industry was represented on the search committee.

Experiment Station used stakeholder input to make more immediate decisions, such as where to invest funding to direct current faculty and their research into emerging issues such as biofuels and alternative drought resistant crops. Stakeholder input was utilized in other activities such as annual budget allocation, providing feedback to the college, departments and faculty, and most importantly, in setting priorities for our Formula Fund research Call for Proposals and deciding how to allocate these funds.
Nevada Cooperative Extension used local, regional and state needs assessments to design, deliver and evaluate programs. Nevada Cooperative Extension used reports from public meetings and processes, participation on commissions and boards of directors, participation in state and regional conferences to:

- allocate funds from all of Extension's sources
- identify emerging issues to be addressed with new or expanded programs
- redirect Extension programs
- hire staff
- develop action plans and set priorities

Brief Explanation of what you learned from your Stakeholders

{NO DATA ENTERED}

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1205024	0	1558154	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1205024	0	1303052	0
Actual Matching	0	0	1332914	0
Actual All Other	0	0	0	0
Total Actual Expended	1205024	0	2635966	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	880916	0

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%		20%	
103	Management of Saline and Sodic Soils and Salinity	0%		4%	
111	Conservation and Efficient Use of Water	8%		0%	
121	Management of Range Resources	18%		6%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		1%	
202	Plant Genetic Resources	0%		5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		20%	
204	Plant Product Quality and Utility (Preharvest)	0%		1%	
205	Plant Management Systems	45%		5%	
206	Basic Plant Biology	0%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	2%		0%	
213	Weeds Affecting Plants	11%		0%	
216	Integrated Pest Management Systems	16%		0%	
301	Reproductive Performance of Animals	0%		2%	
302	Nutrient Utilization in Animals	0%		7%	
307	Animal Management Systems	0%		10%	
504	Home and Commercial Food Service	0%		6%	
511	New and Improved Non-Food Products and Processes	0%		2%	
701	Nutrient Composition of Food	0%		6%	
	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	5.0	0.0	1.8	0.0
Actual Paid	2.7	0.0	5.3	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**
154752	0	447210	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	463559	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

University of Nevada Cooperative Extension focused on the following projects to meet NIFA goals for Global Food Security and Hunger:

Bioplastic pots research
The purpose of the project is to study the decomposition of biodegradable plant containers in different soils and climates (including Nevada's). In this latter part of the project, Nevada led the outreach effort across three states, including Nevada, Iowa and Illinois, to include consumer focus groups and preference surveys to support horticulture industry adoption of the technology.

Grow your own, Nevada
Grow Your Own, Nevada! consists of a series of eight two-hour sessions and covers topics such as vegetable cultivar selection, composting, harvesting and preserving produce. The series is offered twice each year, once in the spring and once in the fall, totaling 16 classes offered in 2016. The goal of the program is to provide individuals, organizations and communities with the information and tools they need to successfully grow food on a small, local scale in Nevada's dry, high-desert climate.

Master Gardeners
Master Gardener volunteers are a critical component of horticulture programs in every land-grant university. Those seeking to become Master Gardener volunteers complete an intensive basic horticulture training including 50 to 80 hours of coursework and hands-on training. They then volunteer at least 50 hours to become a certified Master Gardener volunteer, and must volunteer at least 50 hours each year to retain their certification. Master Gardeners provide research-based horticulture information to Nevadans by answering phone calls, sending out informational materials, conducting workshops, developing community gardens, providing information at farmers markets and other community events, and much more. Master Gardeners expand the reach of Cooperative Extension horticulture professionals and create a vital link between the university, Cooperative Extension and the general public.

Commercial Landscape Horticulture
This "train-the-trainer" program provides opportunities to increase skill level and professionalism within the commercial landscape horticulture industry in Nevada. In Nevada, the needs of the commercial horticulture industry vary among counties and between northern and southern Nevada. Thus, much of this programming is conducted independently, either in northern Nevada or in southern Nevada, rather than as a statewide program. In 2016, northern Nevada's Green Industry Training Program began in winter with an annual basic training series of eight three-hour classes for new and emerging industry workers. During the rest of the year, there were five advanced training classes in northern Nevada providing opportunities for green industry professionals to obtain continuing education credits for professional certification and licensing. Southern Nevada's Basic Principles of Landscape Management component presented 26 classes, ranging from one to four hours per class, and including some in Arizona and New Mexico, with an emphasis on attendees whose second language is English.

Urban Integrated Pest Management
This grant-funded program seeks to increase awareness and adoption of Integrated Pest Management (IPM) strategies by the public and the green industry to manage pests efficiently while protecting human health and the environment. In 2016, the program taught 97 classes.

Integrated Pest Management, IR-4 and Pesticide Safety Education
This program conducts research on, and educates agricultural producers and public land managers on, integrated pest management (IPM) strategies than can be used in place of chemical controls, with weed management being a top priority. The program also conducts educational workshops and trainings in Nevada under the federally mandated Pesticide Safety Education Program (PSEP), to educate and train the general public and pesticide applicators on how to use pesticides safely and effectively. In addition, the program tests pesticides for potential use in producing forages and crops in Nevada and submits requests to the IR-4 Project for federal testing and registration. The IR-4 Project is a USDA Program that works in coordination with the EPA to help collect data in support of registration of pesticides effective and safe to use on minor or specialty crops, not generally grown in the U.S. on a large scale. Nevada also have a very active urban IPM program. The target audience is homeowners, and green industry workers. This part of the program is reported on a separate Impact Statement.

Weed Management Program/Weed Extravaganza
In 2016, for the 10th consecutive year, an event with presentations and a weed identification tour, a Pesticide Applicator Training and Weed Identification & Management Workshop, and a Pesticide Applicator testing opportunity were combined into a three-day "Weed Extravaganza" coordinated by McAdoo near Elko, Nev. Workshops included a wide range of topics aimed at giving land managers, ranchers and agricultural producers the latest information on controlling invasive weeds.

Alternative Crop Production in Nevada
In 2016, work focused on expansion of teff as an alternative crop for Nevada, and pest management for teff; trials involving alfalfa, camelina (a plant that can be used for biofuel), tall fescue and halophytic plants (plants that grow in high-salinity soils); and work to improve efficiency of irrigation.

Corn/Soybean Production in Nevada
In 2016: Nevada Extension presented an all-day program in April to 18 farmers from Pershing and Churchill Counties on the following topics: Introduction to Corn and Soybean Production, Soils/Fertility for Corn and Soybean Production, Corn and Soybean Physiology and Growth Stages, Variety/Maturity Group Selection, Corn and Soybean Production Best Management Practices, Corn and Soybean Enterprise Budgets and Economics, Corn and Soybean Diseases/Insect Control, Corn and Soybean Weed Management, and Relay Intercropping Systems With Wheat.

The **Nevada Agricultural Experiment Station** (NAES) conducted the following programs to further the goals of NIFA's Global Food Security and Hunger theme:

Improving Nutrient Capacity and Drought Resistance in Tomatoes
A protocol to measure root hydraulics in tomato plants was developed based on sand, farm soil and compost. This protocol also promotes root colonization of mycorrhizae fungi. Eight experiments were conducted on two tomato genotypes that differed in their capacity to form symbiotic associations with fungi to understand the effects of drought on root hydraulics and nitrogen availability. Another protocol is still under development to analyze gene expressions; meanwhile, biomass production, nutrient analyses and root anatomical changes were processed and analyzed.

Alternative Crop development for high deserts: Teff
To assess drought/dehydration tolerance and inter-irrigation survival interval, the NAES team evaluated 367 accessions for relative and absolute water content, electrolyte leakage, and photosynthetic activity of leaves at regular intervals during acute drying, upon re-watering and recovery, and following chronic water-deficit stress at fixed irrigation levels to assess rates and limits of water loss, leaf damage, and photosynthetic capacity. Greenhouse trials are in their second year and will repeat what was done in 2016.

In the lab, our NAES scientists were successful in designing, then cloning genome-editing protocols (CRISPR/Cas9 sgRNAs) for targeting genes involved in regulating plant stature. This tool maybe useful in reducing plant lodging, a common problem in windy areas like Northern Nevada.

Evaluation of Wine Grape Cultivars and Clones
An experimental vineyard was planted in Southern Nevada. Stress tolerant rootstocks already screened by the UC-Davis group were grafted with four varieties of wine-grape cultivar and physiological assessments are underway in the hot and dry climate of Las Vegas, Nevada. Note though, vines will take several years to develop before drought experiments will be applied.

Genes thought to be involved in the waxy substance present in the cell walls (suberin) have been cloned and put into small pieces of DNA (vectors). The mRNA (conveys genetic information in the DNA to produce proteins) has been extracted from 240 samples from a large drought and salinity experiment. Transcript analysis of roots and shoots is in progress, a holistic snapshot of a cell that allows for the identification of gene function.

Data collection continues on the plant stress hormone abscisic acid (ABA), to address how applications of ABA to vines in mid-summer affect the cold tolerance of different cultivars in a Northern Nevada climate. During 2016, sample collection began in January and continued every month through bud break in the field. Bud analysis was conducted to determine low temperature exposure and moisture content from all samples collected in 2016. Finally, stem and root sap samples were measured for their osmotic potential to determine what effects ABA had on hydraulic conductance. Additional buds were harvested and frozen in liquid nitrogen for later qPCR or RNA-seq analysis.

Nutritional Management in Cattle Using Chia Seed and/or Flaxseed as a Supplement
For 2016, alfalfa, chia seed, and flaxseed were collected to determine how supplementing chia and flaxseed into an alfalfa hay based diet affected ruminal metabolism. Lab analyses were conducted using dual-flow continuous culture systems (artificial stomachs) to determine dry matter, organic matter, neutral detergent fiber, acid detergent fiber, crude proteins, lipids, and ash. Statistical analysis showed that both chia and flax supplementation improved dietary fatty acid composition and had a positively effect on both ruminal and milk fatty acid profiles. Just as important, supplementation of chia and flax in an alfalfa hay-based diet did not impair ruminal fermentation characteristics, digestibility, microbial efficiency, and ruminal

nitrogen metabolism. From a human health perspective, supplementation of chia (5.5% of diet) when compared to pure alfalfa diets increased the concentration of polyunsaturated fatty acids - known to decrease cardiovascular diseases.

Nutritional Value of Cheatgrass as Alternative Forage for Nevada

This study evaluated the effects of urea, molasses, or a combination of urea and molasses supplementation on a cheatgrass-based diet. The NAES team looked at digestibility, microbial fermentation, bacterial protein synthesis, and nutrient flow using dual-flow continuous culture systems (artificial stomachs). Rumen fluid was collected form cannulated steers, homogenized, and then distributed equally across artificial stomachs. The systems were then feed one of four diets (alfalfa only, alfalfa-urea, alfalfa-molasses, or all three). Statistical analysis showed that the addition of urea and molasses improved nutrient supply to animals, notably volatile fatty acids (energy source for rumen) and microbial nitrogen supplies.

Improving the Seed Set Yield of Plants under Heat, Cold and Drought Stress

Scientists at NAES have tested candidate genes for their potential to increase or decrease pollen fertility during heat-stress. The impact of a transgene or mutation on pollen fitness was quantified by measuring pollen transmission in out crosses done with and without a temperature stress. While modifications to several genes of interest resulted in pollen with decreased fitness, two candidates were identified that could be manipulated to increase pollen fitness by up to 9-fold. Given the uncertainties presented by an increased frequency of hot and cold weather extremes, an urgent goal is to obtain fundamental scientific insights into heat-stress tolerance in plant reproduction that will enable future research into making crop plants more productive. Knowledge obtained here using a model plant Arabidopsis provides a foundation for future engineering of crop plants with enhanced reproductive heat-stress tolerance.

Developing Better Potatoes

Work continues with the two cultivars that differ in their wound healing ability and long-term storage. The NAES investigators have identified single nucleotide polymorphisms in transcription factors (biological markers) that underlie the differential wound healing and storage capacities of these two potato cultivars. Collaborating with Michigan State University, their plant breeders are using these markers to select for better lines in their potato-breeding program. NAES has expanded research efforts to include two more commercially relevant cultivars of potato that also exhibit differential wound healing and storability. Our scientists profiled the expression of the suberin biosynthesis genes (responsible for the waxy skin); demonstrating that these two cultivars exhibit dramatic differences in gene expression during wounding. Further, the NAES team has begun to explore differences in the phenolic composition of the wounded tissue that is known to participate in defense against pathogens.

Optimizing High Desert Hoophouses

Winter varietal study: grew, harvested, and analyzed a number of winter leafy greens and root crops in order to determine feasibility of produce production in hoop house agriculture, as contrasted with production in field plots under ambient weather conditions.

Summer seasonal trials: grew and harvested tomato and watermelon varietals during the summer, testing out the viability of earlier planting times and growing season extension in hoop house agriculture, as contrasted with production in field plots under ambient weather conditions.

Consumer preference surveys: conducted consumer taste testing on produce procured from the summer seasonal trials to ascertain both consumer acceptability of the different tomato varietals grown and the differences in produce quality between tomatoes harvested from early planting versus late planting tomato plants.

Ultraviolet light and antioxidant production within Hoop Houses: the first year of research into the ultraviolet

penetration of hoop houses, and attempting to supplement with additional ultraviolet light to counteract potential loss of antioxidant production were begun.

Characterization of Insect Feed Behavior Hormones: a Novel Mechanism for Pest Management
A new line of research was started this year with the addition of Dr. Andrew Nuss. Using the Tobacco Hornworm as a model insect, genomic regions key in protein production that control feeding behaviors have been identified. DNA amplification and sequencing have also begun, determining how these proteins are distributed throughout the insect during development and under different feeding conditions. Note, the primary focus for year one was to establish a breeding colony of hornworms. This included assembling mating cages, pupal rearing chambers, building diet preparation equipment, and establishing standardized protocol.

Urban Hydroponic Fruit and Vegetable Production
Over the past year, NAES scientists continued investigating the use of hydroponic in strawberry and raspberry production. A collaborative study was done looking at the uptake of nanoparticle carbon materials in lettuce grown hydroponically. A new line of research has begun looking at the feasibility of growing agave and aloe hydroponically. The team was successful in growing both succulents using hydroponic conditions. Starter plants grew and developed a strong rhizome network, in approximately, three months.

Grazing Preferences of New, Alternative, and Popular Forage Crops in Arid Conditions
A new line of research was started this year with the addition of Dr. Juan Solomon. Three experiments were conduct on pastures of orchard grass, tall fescue, and perennial rye grass. Seeded back in 2015, the 2016 orchard grass trials involved three cultivars subjected to three grazing frequencies performed at 55 head of cattle per 2.5 acres. Data was collected and analyzed on biomass accumulation, stand density, height after compression, and nutrient values. Also in 2016, eight cultivars of tall fescue were planted along with five cultivars of perennial rye grass in individual, one hectare, plots. The entire experimental design will be repeated in 2017 on all three species of grass.

Using Salt-Loving Plants to Improve Food Security and Environmental Quality in Dryland Ecosystems
This project started in the fall of 2015, at which time field site preparation was carried out through spring of 2016. This included installation of irrigation equipment and soil sensors, salinity amendments were add, and either quinoa, a hybrid wheatgrass (AC Saltlander), rabbitbrush, or gumweed were planted from seed. Quinoa was sampled throughout the study to estimate biomass. In addition, surface soil salinity was measured biweekly in each plot. At the end of the growing season, Quinoa and AC Saltlander were harvested and analyzed for biomass production and salt content and results are currently being analyzed. The team also conducted a greenhouse study assessing the effects of soil and irrigation salinity on Quinoa and AC Saltlander biomass production and salt uptake.

Mathematical modeling efforts are ongoing and the APEX model (an Agricultural Policy/Environmental eXtender model) has been parametrized using greenhouse and field data. APEX was constructed to evaluate various land management strategies considering sustainability, erosion, economics, water supply and quality, soil quality, plant competition, weather, and pests. One of the key components of the model that needs to be incorporated is how salts are taken up by the vegetation. Currently, different routines are being tested incorporating both active and passive salt uptake.

Animal Health: Foothill Abortion (Epizootic Bovine Abortion or EBA)
Over the past year, 2,500 heifers and susceptible cows have been vaccinated in EBA endemic areas across California, Nevada and Oregon, bring the grand total to over 10,000 animals. From the research standpoint, NAES investigators challenged three groups of cattle that had previously been immunized two years at either a low, or a high dose of vaccine and a third group of cattle, consisting of cows naïve to EBA

were used as controls. All of the animals in the study had their antibodies against the bacterial pathogen measured quarterly since they were immunized two years ago. Monthly blood collections and pregnancy detection were performed on the animals in the study since challenge. Due to the long gestational period of cattle, the results of this experiment will not be known until winter of 2017.

Characterization, Development, and Enhancement of Wood Tissue in Forage Crops and Feedstock
NAES scientists working on the production of cellulose in plants spent the majority of their time identifying a new protein that directly controls cellulose biosynthesis in the model plant Arabidopsis. It was also shown that this protein when activated reduces total cellulose composition. Through this discovery, the actions that are causing reduced amounts of cellulose produced in the plant are now being transferred into mutant genes that block this action. Testing is continuing to determine if these mutants produce additional cellulose.

Another area of focus that received attention this year was the work conducted on the plant stress hormone abscisic acid (ABA). The team showed that ABA disruption, while the plant is being stressed, allowed for greater root growth in two species of plants. They also were able to link this action to previously known mechanisms that control root hair development.

2. Brief description of the target audience

University of Nevada Cooperative Extension target audience included:

Bioplastic Pots Research: Plant-container manufacturers, production and retail nurseries, and the gardening public.
Grow your own, Nevada: Homeowners, community gardeners and small-scale food producers.
Master Gardeners: General public, small-scale commercial and backyard producers, traditional large commercial producers.
Commercial Landscape Horticulture: The targeted audience are members of the commercial landscape horticulture industry, including nursery workers and owners, arborists, pesticide applicators, landscapers, irrigation specialists, landscape designers and architects.
Urban Integrated Pest Management: General public, green industry professionals, Master Gardeners, pesticide applicators.
Integrated Pest Management, IR-4 and Pesticide Safety Education: Nevada agricultural producers, land managers, pesticide applicators, policymakers, state and federal partners in weed management, beekeepers.
Weed Management Program/Weed Extravaganza: Public and private land managers, including ranchers, farmers, property owners, resource consultants, agency natural resource specialists, conservation district leaders, mining personnel, and Native American tribal members.
Alternative Crop Production in Nevada: Nevada agricultural producers, government officials and policymakers.
Corn/Soybean Production in Nevada: Farmers and producers in northern Nevada.

Nevada Agricultural Experiment Station (NAES) target audience included:

The scientific community, agriculture producers, veterinarians, local organizations, backyard hobbyists, as well as students taking classes or participating in research activities, beginning and existing small acreage operators and large-scale crop and livestock (primarily beef/dairy/sheep) producers. USDA agencies and other government entities that conduct work in this area are an audience and frequently a program partner. Additional audiences include agricultural service industries, lenders, and policy makers at the local, state, and federal levels.

3. How was eXtension used?

eXtension was not used.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	63210	11245	2776	245

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	17	27	27

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Undergraduate Students Involved in Research.

Year	Actual
2016	57

Output #2

Output Measure

- Number of Graduate Students or Post-Doctorates Trained.

Year	Actual

2016	29

Output #3

Output Measure

- Workshops, Demonstrations, and Presentations

Year	Actual
2016	90

Output #4

Output Measure

- Abstracts, Books, Book Chapter(s), Proceedings, Research Reports, and Technical Publications

Year	Actual
2016	6

Output #5

Output Measure

- Brochures, Bulletins, Fact Sheets, Newsletter, and Surveys

Year	Actual
2016	10

Output #6

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	0

Output #7

Output Measure

- Digital Media and Web Sites Created or Updated

Year	Actual
2016	4

Output #8

Output Measure

- Databases, Models, and Protocols

Year	Actual
2016	5

Output #9

Output Measure

- Leveraged research funds generated

Year	Actual
2016	1385800

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of clientele who gain knowledge about improved human, plant, and animal management systems for sustainable agriculture.
2	Number of clientele who implement improved human, plant, and animal management systems for sustainable agriculture.
3	Advance research knowledge, both basic and applied, in the areas of production agriculture to existing and emerging industry and consumer demand regarding genetics, biology, seed production, nutrition, and related topics.
4	Vaccine Trials for Epizootic Bovine Abortion (a.k.a. Foothill Abortion)
5	Improving quality of beef using chia and flax seed supplements
6	Decreasing water usage while maintaining yields in tomatoes
7	Genetic identification of leaf dehydration responses in grapes.

Outcome #1

1. Outcome Measures

Number of clientele who gain knowledge about improved human, plant, and animal management systems for sustainable agriculture.

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)

Bioplastic Pots Research: The variety and number of plants grown in containers is astonishing. In the U.S. alone, more than 4.5 billion containerized plants are produced each year by the horticulture specialty-crops industries, and nearly all of them are grown in single-use, petroleum-based plastic containers. Efforts are made by a few to re-use or recycle some of these containers, but unfortunately less than 2% are repurposed, and 98% end up in the solid waste stream. Grow your own, Nevada!: Master Gardeners: Commercial Landscape Horticulture: A major area of program emphasis for Cooperative Extension is to improve food security through home and small-scale production. Many communities (29 out of 487 census tracts) in Nevada are considered food deserts: they have limited access to fresh foods. Many Nevadans desire to grow their own foods to gain access to safe and healthy produce and to become more self-sufficient. Urban Integrated Pest Management: Data from the National Water Quality Assessment Program published in 2006 revealed that the Truckee River had only one pesticide detected in water samples upstream from Reno-Sparks, but 10 compounds were detected downstream of the two cities, suggesting urban inputs to the pesticide load. Historically, studies have shown that homeowners use as much as 10 times more chemicals per acre on their lawns than farmers use on agricultural land. Integrated Pest Management, IR-4 and Safety Education: Weed Management Program/Weed Extravaganza: Noxious weeds pose major challenges to those managing public lands, ranches, farms and other landscapes. Invasive weeds can out-compete native vegetation, crops and livestock forage. These invasive weeds can also pose fire hazards, lead to erosion and water quality issues, and impact wildlife habitat. Alternative Crop Production in Nevada: Surface irrigation water supplies have been greatly reduced, and groundwater levels are dropping in many locations. Needs assessments have identified issues related to water quantity as the highest priority need for Nevada agricultural producers. Producers need to know the most efficient ways to irrigate, including management strategies and new technologies; and how to manage alfalfa and other forages in times of water shortages. Corn/Soybean Production in Nevada: Alfalfa hay, alfalfa seed and small grains are the principle crops produced in Pershing County. Alfalfa hay

remains by far the most important crop in terms of both acres harvested and value of production. Despite an 80% reduction in alfalfa seed acreage over the last eight years, it remained in second place followed by other hay production.

What has been done

Bioplastic Pots Research: In 2016, the team published their final results and recommendations for industry adoption of the technology in the book, Bioplastic Container Cropping Systems: Green Technology for the Green Industry. Grow Your Own, Nevada!: offered two eight-class sessions in 2016: one in the spring and one in the fall. Master Gardeners: Across the state, Master Gardeners volunteered for 60,517 hours in 2016, including 9,500 in Washoe County, 1,109 in Douglas County, 24 in Humboldt County, 35,000 in Clark County, 8,054 at the University of Nevada Cooperative Extension Research and Demonstration Orchard (includes hours from 40 Master Gardeners and other volunteers) and 6,830 in Nye County. Commercial Landscape Horticulture: Nevada Extension offered eight advanced training continuing education classes offered, including four in both English and Spanish. Bilingual classes included pesticide safety, integrated pesticide management, hands-on pruning and planting techniques. Some other topics included artificial turf, keeping trees alive during drought, and soil science and water management of trees. Urban Integrated Pest Management: Nevada Extension offered eight advanced training continuing education classes, including four in English and Spanish, focused on pesticide safety, integrated pesticide management, hands-on pruning and planting techniques. Some other topics included artificial turf, keeping trees alive during drought, and soil science and water management of trees. Southern Nevada?s Basic Principles of Landscape Management presented 26 classes averaging an hour each in 2016, with an emphasis on attendees whose second language is English. Training topics included planting and caring for trees, integrated pest management, and general landscaping. Some of the classes taught hands-on application using the botanical garden located at the Clark County Cooperative Extension office. Integrated Pest Management, IR-4 and Pesticide Safety Education: In 2016, some of the program accomplishments included workshops related to pollinators and pollinator management, pesticide safety education, and pesticide use on an emerging alternative crop (pumpkins). Nevada Extension submitted a petition to the EPA through the Nevada Department of Agriculture to have the insecticide, chlorantraniliprole (Prevathon) labeled for insect control in teff in Nevada, which was approved. Weed Management Program / Weed Extravaganza: The Weed Management Program focused on teaching weed identification and management, along with revegetation to compete with weeds, to private and public land managers and weed control specialists. On the third day of the Extravaganza, in cooperation with the Nevada Department of Agriculture, the Pesticide Applicator Exam was offered. Alternative Crop Production in Nevada: This year, approximately 1,500 acres of teff were planted in four counties, of which approximately half were planted by new growers of teff. Total teff production in these counties for the year was 2.6 million pounds, valued at $1.2 million, the largest harvest in the state to date. The EPA granted a Section 18 emergency pesticide exemption request in July 2016 that allowed Nevada farmers to treat approximately 750 acres of teff with the newly permitted insecticide, Prevathon, with no resultant damage to the crop from Army cutworms. Corn/Soybean Production in Nevada: Nevada Extension presented information on corn and soybeans, a non-traditional crop.

Results

Bioplastic Pots Research: The Nevada program website, www.nevadabioplastics.com, is generating interest among nursery growers in the technology, and at least two U.S. plastics companies are testing the project's prototype plant containers for commercial production. Grow Your Own, Nevada!: Over 90% of respondents to surveys administered to classes and activities reported knowledge gains. Master Gardeners: Master Gardeners who took classes reported significant knowledge gains. Nevada Extension estimates that the value of Master Gardener services was $1,425,780.52 in six counties.

Commercial Landscape Horticulture: participants reported knowledge gains across a wide spectrum of topics.

Urban Integrated Pest Management: Nevada Extension plans to evaluate this program in 2017. Integrated Pest Management, IR-4 and Pesticide Safety Education: As part of a long-term program, the IPM program has documented an increase in stakeholder adoption of IPM practices, and an increased use of alternatives to pesticides or pesticides being used in synergy with other control methods. The target audience has shown an increased in awareness of the resources available for pest identification and of weeds that are newly being established in Nevada. They are also demonstrating an increased ability to solve pest management issues independently. Summaries of five years of surveys of this target audience are being compiled for publication.

Weed Management Program / Weed Extravaganza: Attendees learned to identify noxious weed species in various stages of the plant lifecycle, as well as research-based weed control and revegetation methods. Attendees indicated that they learned useful information they intend to apply, including using more integrated weed management, keeping better records, applying herbicides to complex perennials differently, and applying herbicides at the appropriate time based on plant life cycles. The Pesticide Applicator Training / Weed Identification & Management Workshop had 51 attendees. Participants reported that they intended to change or improve their practices as a result of attending the workshop, including calibrating equipment, improving record-keeping, applying herbicide at the appropriate time, applying herbicide at the appropriate rate, and using the weed mapping application.

Alternative Crop Production in Nevada: Post event surveys indicated that participants planned to change practices and to explore adoption of alternative crops.

Corn/Soybean Production in Nevada: Farmers who attended the program in 2016 completed a post-program evaluation, which asked, Did you gain any knowledge from this soybean production training? The Likert-type scale used was: 1 = no new knowledge, and 5 = significant knowledge. The average of all topics presented was equal to 4.79. 100% of participants indicated that they would consider growing corn or soybeans on their farming operations from the information provided during this training.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
121	Management of Range Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
307	Animal Management Systems

Outcome #2

1. Outcome Measures

Number of clientele who implement improved human, plant, and animal management systems for sustainable agriculture.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Advance research knowledge, both basic and applied, in the areas of production agriculture to existing and emerging industry and consumer demand regarding genetics, biology, seed production, nutrition, and related topics.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Potato is the third most-consumed food crop in the world and one of the five most important crops in Nevada. It is estimated that climate change will result in up to 32% losses in US potato yields over the next 30 years unless measures are taken to improve plant tolerance to conditions like drought stress. About 18% of the potato crop is lost each year due to damage to potato tubers both during and after harvest and other post-harvest issues. The goal of this research is to obtain a fundamental understanding of how potatoes make suberin in response to wounding, bruising, and drought.

What has been done
Work continues with the two cultivars that differ in wound healing and long-term storage. The Ag Experiment Station investigators have identified single nucleotide polymorphisms in transcription factors (biological markers) that underlie the differential wound healing and storage capacities of these two potato cultivars.

Results

Through the work conducted at the University of Nevada that identified biological marker associated with better wound healing and improved storage capacity, Michigan State University plant breeders have incorporated these markers into their potato-breeding program to insure high quality potatoes.

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

Outcome #4

1. Outcome Measures

Vaccine Trials for Epizootic Bovine Abortion (a.k.a. Foothill Abortion)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Epizootic Bovine Abortion (EBA), commonly known as Foothill Abortion, is one of the major diseases responsible for reducing calf production on ranches in western and northern Nevada, California, southern Idaho and southern Oregon. Although infected pregnant cows do not show visible signs of illness, many of them abort their fetuses at six to nine months of gestation. A significant number of infected cows carry their calves to term, but the calves delivered are weak, fail to thrive and tend to die within the first weeks of independent life.

What has been done
Over the past year, 2,500 heifers and susceptible cows have been vaccinated in EBA endemic areas across California, Nevada and Oregon, bring the grand total to over 10,000 animals.

Results
The University of Nevada, in collaboration with UC-Davis have identify the organism causing the devastating disease and successfully developed a live vaccine to protect cows against the

disease.

"The vaccine is huge for the industry," said Tom Talbot, Bishop, CA beef producer and livestock veterinarian. "I don't think we fully understand the magnitude of the economic loss suffered from aborted calves."

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
307	Animal Management Systems

Outcome #5

1. Outcome Measures

Improving quality of beef using chia and flax seed supplements

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)
Because chia and flax seed are high in oil, it is considered a fat source in livestock rations. Fats traditionally have been used in livestock diets to increase energy density, reduce dust, eliminate fines and aid in processing such as pelleting. Generally, fat is limited to 5 percent of dry matter weight in ruminant diets because fats can interfere with rumen fermentation. Using both artificial rumen systems and live cattle, the team focused on the detailed effect of supplementing chia and flax in cattle diets.

What has been done
For 2016, alfalfa, chia seed, and flaxseed were collected to determine how supplementing chia and flaxseed into an alfalfa hay based diet affected ruminal metabolism. Laboratorial analyses were conducted using dual-flow continuous culture systems (artificial stomachs) to determine dry matter, organic matter, neutral detergent fiber, acid detergent fiber, crude proteins, lipids, and ash.

Results
Our data demonstrated that both chia and flax supplementation improved dietary fatty acid composition and had a positively effect on both ruminal and milk fatty acid profiles. Just as important, supplementation of chia and flax in an alfalfa hay-based diet did not impair ruminal fermentation characteristics, digestibility, microbial efficiency, and ruminal nitrogen metabolism. From a human health perspective, supplementation of chia (5.5% of diet) when compared to pure alfalfa diets increased the concentration of polyunsaturated fatty acids - known to decrease cardiovascular diseases.

4. Associated Knowledge Areas

KA Code	Knowledge Area
302	Nutrient Utilization in Animals
307	Animal Management Systems
511	New and Improved Non-Food Products and Processes

Outcome #6

1. Outcome Measures

Decreasing water usage while maintaining yields in tomatoes

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Future constraints on water availability due to drought and increasing urban water demands require efficient irrigation strategies to reduce the amount of agricultural water use. Furrow irrigation is often considered to have low water use efficiency and may generate high volumes of runoff water that contribute to erosion and potential nutrient and pesticide pollution. By integrating plant physiological responses to soil water availability, furrow irrigation practices can potentially reduce water application without affecting crop productivity.

What has been done
A series of trials were conducted in two consecutive years and three soil types to evaluate tomato crop performance under alternate furrow irrigation verses every furrow irrigation. Crop growth and

leaf gas exchange, fruit biomass and quality, soil moisture and water applied were evaluated; along with changes in irrigation water productivity were determined in response to partial root zone drying created when alternating furrow irrigation.

Results
The alternate furrow irrigation was consistent in maintaining fresh yields across cultivars and environmental conditions (i.e., years and soil textures) with at least 25% lower irrigation volumes than commonly applied under every furrow irrigation. The change in water productivity increased by greater than 29% and maintained fruit quality.

This study shows that existing tomato cultivars are physiologically capable to respond positively to innovative irrigation practices that increase the efficient use of resources. Alternate furrow irrigation can increase the efficient use of water without requiring capital investment (e.g., labor or equipment), a limiting factor in many areas around the world. Adapting the concept of partial root zone drying and plant physiological response to other crop species and irrigation methods (e.g., drip or low-sprinkler irrigation) should be possible. Because of the extent of furrow irrigation worldwide, alternate furrow irrigation can contribute to maintain highly productive agricultural lands with lower water supply.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

Outcome #7

1. Outcome Measures

Genetic identification of leaf dehydration responses in grapes.

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)
Grapevine is a major food crop that is affected by global climate change. Consistent with field studies, dehydration assays of grapevine leaves can reveal valuable information of the plant's response at physiological, chromosome transcription, and protein levels. There are well-known differences in grapevine rootstocks responses to dehydration. We used time-series transcriptomic approaches combined with network analyses to elucidate and identify important physiological processes and network hubs that responded to dehydration in three different grapevine species differing in their drought tolerance.

What has been done
Three grapevine genotypes (Cabernet Sauvignon, French table grapes, and four varieties of US native grapes) were pruned and grown in pots. Vines were grown in a greenhouse with supplemental sodium vapor lamps. Fully developed leaves were subjected to dehydration. Leaves were removed from dehydration boxes at 1, 2, 4, 8, and 24 hours and frozen immediately in liquid nitrogen. Control leaves were taken from the second shoot of the intact plant at the corresponding daytime of the dehydration assay to account for circadian effects on transcript abundance. RNA quality and quantity were assessed; microarrays were hybridized; and microarray analysis was conducted.

Results
A leaf dehydration assay provided evidence for differential leaf responses to dehydration between genotypes differing in their drought tolerance. These network analyses proved to be a powerful approach; it identified 30 distinct modules (networks) with highly enriched gene categories and enabled the identification of gene hubs in these modules. Some of these genes were highly connected hubs in plant hormones like ABA and ethylene signaling pathways, supporting the hypothesis that there is substantial crosstalk between hormone pathways.

This study identifies solid gene candidates for future investigations of drought tolerance in grapevine.

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
206	Basic Plant Biology

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Nevada agricultural producers have faced a record-breaking drought over the past five years. They need to know the most efficient ways to irrigate, and how to manage alfalfa and other forages in times of water shortages. There is also a need to identify, evaluate and commercialize crops that use less water while returning equal or higher economic returns than the forage crops currently grown in Nevada.

Drought affected Nevada Extension's corn and soybean trials and increased interest in these crops. Corn has shown to be a viable alternative crop that is not especially high-water-use. Five years of drought increased the need to provide educational programs on controlling noxious weeds, which are opportunistic and can especially outcompete beneficial native vegetation during extreme conditions such as drought.

Dry conditions lead to increased potential for wildfire and an increased need to control noxious weeds that quickly dry up and become fuel for potential wildfires. The drought in northern Nevada led to a demand for training related to developing landscapes better suited for an extremely dry climate. Also, due to a sharp increase in the Hispanic population throughout the state, curriculum was adjusted to reach both English and Spanish speakers. As Nevada's drought intensified, the demand for low-water-use gardening information increased. This led to the addition of drought-related topics to the curriculum.

As the economy dropped, interest in growing food at home increased. This led to an increase in interest in the program.

Tomato research is very dependent on field plots. Soil and growing conditions in Northern Nevada trend towards poor soil structure, low infiltration capacity, and plant lodging due to wind, making production all the more difficult.

Grape research on ABA's effect on delaying bud break in the spring have been inconclusive due to mild winters and herbicide damage to numerous research plots.

Nutritional value of prickly pear cactus as alternative forage for Nevada has been delayed due to issues revolving around drying the pads and the shear volume of fresh plant material need to obtain a minimum amount of dry biomass.

Without the assistance of professional plant breeders, establishment of rabbit brush and gumweed have proven to be very difficult as best and next to impossible for soil scientists and hydrologists with no experience in high desert plant propagation. Thus, the project involving salt-loving plants has dropped these species.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

University of Nevada Extension Evaluations:

Bioplastic Pots Research:

The follow-up survey three months after the strawberry plant/bioplastic container sale produced the following results (N=40):
- Most plant sale participants selected their plants based on strawberry variety, not pot type.
- 65% of survey respondents reused/repurposed their pots, and 43% composted them. Only 38% broke up the pots and placed them in the planting hole with their strawberries plants, as instructed.
- Pot appearance is critical to the end-of-life fate of bioplastic pots in the hands of consumers. For example, one survey respondent stated that the pots they purchased didn't look biodegradable, so they discarded them in the trash. Since its publication in late 2016, the book has been accessed and read by more than 50 scientists and practitioners, according to the online academic publication tracking system, ResearchGate. The Nevada program website, www.nevadabioplastics.com, is generating interest among nursery growers in the technology, and at least two U.S. plastics companies are testing the project's prototype plant containers for commercial production.

Grow Your Own, Nevada!:
In addition to the information presented above in the Quantitative Outcome/Impact section, the participants responding to the aforementioned survey reported the behaviors/facts below. (These survey results are presented here because we cannot be certain these facts reflect a change in behavior; we simply know the respondents reported these facts/behaviors after participating in the program.). 55 out of 60 respondents (91.7%) said the produce they grow helps feed their family. 26 out of 60 respondents (43.3%) said they donate some of their homegrown produce to local food pantries. 10 out of 60 respondents (16.7%) said they started their own business producing food for sale. 6 out of 60 respondents (10%) said they sell some of their produce at local farmers markets. 3 out of 60 respondents (5%) said they helped start a community garden or farmers market. 2 out of 60 respondents (3.3%) said the money they earn from selling their produce is an important source of income for their family. 68 out of 72 respondents (94.5%) appreciated the diversity of topics in the classes. 67 out of 71 respondents (94.4%) will attend future Grow Your Own, Nevada! classes. In addition, the number of web visits to www.growyourownnevada.com was 23,237 from January to December 2016, indicating great interest in the program.

Master Gardeners:
The following numbers are the perceived increase in knowledge in three two-hour, one-time advanced Master Gardener training classes taught by Nevada Extension in Washoe County during the year: The Native Plants in the Garden class had 29 attendees who showed a 57% increase in knowledge. The Seed Saving class had 19 attendees who showed

a 98% increase in knowledge. The GMOs Facts and Myths class had 30 attendees and showed a 107% increase in knowledge. Washoe County Master Gardeners taught 650 participants in the Gardening in Nevada: The Bartley Ranch Series; sold 1,125 strawberry plants through an online sale; completed 79 soil tests; responded to 2,486 plant diagnostic requests; and provided information to 1,711 community members through community events and presentations, including the Reno Home Show and University of Nevada, Reno's Field Day. In Douglas County Master Gardeners participated in Gardnerville's Community Beautification Project by hanging and planting flowers. They planted 60 pots of flowers as part of Adopt-a-Pot, and they hung 58 baskets of flowers. In Clark County, participants who attended Master Gardener classes showed a significant increase in knowledge. More than 800 people visited the University of Nevada Cooperative Extension Research and Demonstration Orchard to obtain produce and learn what fruit and vegetables grow in southern Nevada. Nye County Cooperative Extension made contact with at least 94 community members through workshops, 130 community members at Master Gardener events and 1,140 community members at community events. They also taught 120 children and worked with teachers at the Rosemary Clark Middle School Garden about how to grow vegetables with correct soil and raised-bed preparation.

Commercial Landscape Horticulture:
Attendance at the spring Green Industry Training Program in northern Nevada averaged 48 people at each of eight sessions. Some results of two basic classes taught by Nevada Extension include: The Soils, Potting Mixes & Fertilizers class participants showed a 24.2% gain in confidence. The Water and Landscapes class participants showed a 15.4% gain in confidence. Some other specific accomplishments achieved as part of the program in northern Nevada include: The program reached 55 students by hosting "Keeping Your Trees Alive During a Drought" with outside speakers funded by a grant from the Nevada Division of Forestry. The program reached 30 attendees at the Nevada Shade Tree Council Arborist Prep Course on "Soil Science and Water Management of Trees."

Irrigation & the Green Industry Magazine interviewed a member of Nevada Extension for an article titled, "Is Getting Rid of Turf Really the Answer?" published in the magazine supplement Drought and the Green Industry. A member of Nevada Extension received the Nevada Landscape Association President's Award for outstanding service to the industry. In Clark County, classes reached more than 1,260 attendees, of which at least 275 were Hispanic. Below are some of the specific accomplishments achieved as part of the program in southern Nevada. Nevada Extension provided hands-on training to 65 students in the Clark County Living Learning Center's botanical garden, reached 85 students through a training co-sponsored with Target Pest Control and 100 students through a training co-sponsored with the Nevada Department of Agriculture, taught 75 students at the International Society of Arboriculture Palm Conference, facilitated a Tree Appraisal Class with 40 students, cosponsored a 21-year-old program, Desert Green, which is a two-day conference with 36 classes presented over the two days to 250 participants from the Green Industry, taught 100 students in Yuma, Arizona and taught 75 students in Las Cruces, New Mexico.

Urban Integrated Pest Management:
A retrospective survey of the general public will be implemented in 2017 to determine impacts of our IPM public service announcements (radio and TV) and other educational strategies (public classes, fact sheets, professional trainings). See Quantitative Outcome/Impact above for more information on change in knowledge and behavior. Some additional accomplishments/results include: 10 IPM series fact sheets displayed at 13

garden centers, seven Cooperative Extension offices and seven Washoe County public libraries. At least 1,000 fact sheets were delivered in 2016 to these sites to replace fact sheets distributed to the public. 2000 public service announcements aired - 182 on radio, 1,818 on television. At the Reno Home Show booth, Master Gardeners answered 235 questions about IPM, pests or pesticide safety. 500 fact sheets (10 of each topic) were distributed. 2,689 contacts were made through classes. Master Gardeners reached 50 people at Celebrate Washoe Valley, and 50 people at University of Nevada, Reno's Nevada Field Day. Master Gardeners also distributed 90 IPM fact sheets at Field Day. Horticulture staff and Master Gardeners at the Washoe County Cooperative Extension horticulture office answered 1,865 questions that concerned IPM-related topics. The Urban IPM team published 67 articles on IPM-related topics in the Reno Gazette-Journal, the Douglas Record-Courier and the Nevada Appeal.

Integrated Pest Management, IR-4 and Pesticide Safety Education:
As part of a long-term program, the IPM program has documented an increase in stakeholder adoption of IPM practices, and an increased use of alternatives to pesticides or pesticides being used in synergy with other control methods. The target audience has shown an increased in awareness of the resources available for pest identification and of weeds that are newly being established in Nevada. They are also demonstrating an increased ability to solve pest management issues independently. Summaries of five years of surveys of this target audience are being complied for publication.

Weed Management Program / Weed Extravaganza:
The 2016 Weed Extravaganza had 55 attendees. Attendees learned to identify noxious weed species in various stages of the plant lifecycle, as well as research-based weed control and revegetation methods. Attendees indicated that they learned useful information they intend to apply, including using more integrated weed management, keeping better records, applying herbicides to complex perennials differently, and applying herbicides at the appropriate time based on plant life cycles. The Pesticide Applicator Training / Weed Identification & Management Workshop had 51 attendees. Participants reported that they intended to change or improve their practices as a result of attending the workshop, including calibrating equipment, improving record-keeping, applying herbicide at the appropriate time, applying herbicide at the appropriate rate, and using the weed mapping application.

Alternative Crop Production in Nevada:
In 2016, there were approximately 1,500 acres of teff planted in Churchill, Lyon, Mineral and Pershing Counties, of which approximately 700 acres were planted by individuals who had never previously grown teff. Total 2016 teff grain production in these counties was 2.6 million pounds, valued at approximately $1.2 million, by far the largest harvest ever in the state. This crop used approximately two-thirds as much water as traditional crops. On July 18, 2016, the EPA granted the Section 18 emergency pesticide exemption request that Davison helped to prepare and submit. Approximately 750 acres of teff were treated with the newly permitted insecticide, Prevathon, with no resultant damage to the crop from Army cutworms in spite of economically damaging cutworm populations. If the insecticide had not been available and applied, damage causing a loss of nearly one million pound would have likely occurred.

Alfalfa, Camelina, Tall Fescue and Halophytic Plant Trials
The 2015 alfalfa trial was harvested four times in 2016 with the yield and quality data recorded, and publication prepared and submitted for peer-review. All of the other field

trial projects were harvested and/or evaluated, with the data currently being analyzed for preparation of several fact sheets and Journal publications. All are first-year projects. Irrigation Efficiency and New Technologies: Due to the irrigation research project conducted in Churchill, and the subsequent presentations on the research, the Truckee Carson Irrigation Board of Directors voted to allow agricultural producers in the Newlands irrigation project to initiate irrigation a full month earlier than in previous years. This is critical as numerous studies have demonstrated that early irrigations produce more yield of alfalfa per increment of irrigation water applied than later irrigations.

Corn/Soybean Production in Nevada:
Farmers who attended the program in 2016 completed a post-program evaluation, which asked, "Did you gain any knowledge from this soybean production training?" The Likert-type scale used was: 1 = no new knowledge, and 5 = significant knowledge. The average of all topics presented was equal to 4.79. 100% of participants indicated that they would consider growing corn or soybeans on their farming operations from the information provided during this training. When asked how much profit could be realized per acre from attending this program, participants' responses ranged from $1 - $10 per acre. Participants represented a total of 10,800 acres. These responses corresponded to a possible increase in profitability of $54,000 to $92,000 realized by all participants. Over 4,500 acres of corn were planted during 2016 in Pershing County, far exceeding the number of corn acres ever planted in this area.

Nevada Agricultural Experiment Station Evaluations

Tomato research in Nevada has been advanced through the development of a root hydraulic protocol that measures hydrostatic and osmotic pressures.

Cabernet Sauvignon exposed to the plant stress hormone ABA for increasing increments of time shows increased osmotic pressure in the xylem sap. This observation could explain a stress tolerance mechanism that allows grapevines to adapt to drought and salt stresses by adjusting their osmotic potential relative to the gradient they are exposed to, allowing for better uptake of water.

With the understanding that cattle eating cheatgrass as their main source of forage during the fall season is not perfect, our research team has developed recommendations of supplementation ratios of urea, molasses, or a combination of urea and molasses that will improve rumen digestion and the associated microbial environment.

With regard to improving reproduction in plants to withstand temperature stress, modifications to several genes of interest resulted in two candidates that could be manipulated to increase pollen fitness by up to nine-fold.

Our potato scientist have identified genetic based biological markers that underlie the differential wound healing and storage capacities of these two potato cultivars. Collaborating with plant breeders at Michigan State University, their are using these markers to select for these better lines in their potato-breeding program.

Research into plants highly adapted to living in soils heavily laden with salt finally established research plots in the field. Combining work from both the greenhouse and the newly established research plots, the APEX model now has realistic parameters to simulate daily changes, all the way to hundreds of years if necessary.

An insect breeding facility has been established at the University to aid research dealing with pest management in forage agronomy and forestry.

Over the past year, 2,500 heifers and susceptible cows have been vaccinated in Foothill Abortion (Epizootic Bovine Abortion or EBA) endemic areas across California, Nevada and Oregon; bring the grand total to over 10,000 animals.

In direct relation to the cellulose research, the team identified a mutant of one of the cellulose proteins that is more active and produces more cellulose under varying conditions. This mutant can be introduced into agronomically relevant crops to increase wood tissue production for biofuel and forage feed applications.

Our researchers have uncovered a novel signaling process that relates root hair biogenesis to abiotic stress. This signaling process can be manipulated for enhanced nitrogen fixation in arid environments.

Key Items of Evaluation

- Studies into grape leaf dehydration responses identifies solid gene candidates for future investigations of drought tolerance in grapevine.
- In both chia and flax supplementation in cattle diets, improved dietary fatty acid composition had a positively effect on both ruminal and milk fatty acid profiles. From a human health perspective, supplementation of chia (5.5% of diet) when compared to pure alfalfa diets increased the concentration of polyunsaturated fatty acids - a good thing when considering cardiovascular diseases.
- In collaboration with plant breeders at Michigan State University, our genetic markers are being used to select for better lines of wound-healing potatoes in their breeding program.
- Our Foothill Abortion data indicates that producers that were once suffering 40% to 60% losses of their calf crops now report less than a 5% loss. This equates to a significant increase in annual income for the ranching families that have participated in this program.
- Indirect fluorescent antibody test used for detecting the presents of Foothill Abortion infections was developed with support from this grant (see Blanchard et al., Journal of Veterinary Diagnostic Investigations 2014).

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change, Natural Resource Management, and Environmental Science

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%		22%	
111	Conservation and Efficient Use of Water	7%		0%	
112	Watershed Protection and Management	18%		11%	
121	Management of Range Resources	21%		41%	
122	Management and Control of Forest and Range Fires	7%		0%	
123	Management and Sustainability of Forest Resources	0%		5%	
132	Weather and Climate	14%		0%	
133	Pollution Prevention and Mitigation	0%		4%	
135	Aquatic and Terrestrial Wildlife	7%		13%	
136	Conservation of Biological Diversity	11%		4%	
205	Plant Management Systems	4%		0%	
307	Animal Management Systems	4%		0%	
723	Hazards to Human Health and Safety	7%		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	2.0	0.0	3.0	0.0
Actual Paid	2.9	0.0	3.5	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**
136929	0	500374	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	515761	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

University of Nevada Cooperative Extension conducted the following programs to further the goals of NIFA's Climate Change, Natural Resource Management, and Environmental Science theme:

Carson River Watershed and Floodplain Education Program
A team led by Nevada Extension works to educate Nevada communities about assessing and maintaining riparian areas (green zones near water) with classes on how plants, soil/landform and water should work together in riparian areas; how to identify what's not working; and how to fix it.

Climate Change Education Workshop and Partnership
University of Nevada Cooperative Extension is collaborating with the Southwest Regional Climate Hub of the U.S. Department of Agriculture's Agricultural Research Service and with Cooperative Extensions in Arizona, California, Hawaii, New Mexico and Utah to develop and present curriculum about climate-smart agriculture.

Drought-Resiliency in Small Town Groundwater Supplies
Nevada Cooperative Extension educated community officials using computer modeling studies of aquifers supplying drinking water to 12 rural northern Nevada towns. Cooperative Extension obtained interpreted the modeling study and presented summaries of the results to the county commissions of the counties where the public water supplies were located.

Awareness Week and Media Campaign for Nevada Flood Hazards
This inter-agency effort led by Nevada Cooperative Extension was designed to increase public awareness of and preparedness for flood events in northern Nevada. In 2016, the group organized 13 public awareness events.

Flash Flood Education and Citizen Groups
Since the damaging flash floods of 2014 and 2015, University of Nevada Cooperative Extension resumed outreach to vulnerable residents of alluvial fan neighborhoods in several northern Nevada counties. County planners and commissioners, Bureau of Land Management staff, and citizens of neighborhoods that are at risk from flash flooding.

Eagles and Agriculture
Eagles and Agriculture is a multiple-day celebration of agriculture to help people learn about agriculture and the benefits it provides to wildlife and the community. The program encourages the conservation and prosperity of ranching in western Nevada, teaches participants about wildlife and the history of agriculture

in Carson Valley, and creates an agritourism model that enhances the profitability of local farming and ranching businesses.

Sage Grouse Conservation Facilitation
Nevada Extension met with local area working groups 10 times across the state and participated in multiple Executive Oversight Committee meetings with state and federal agency heads. Cooperative Extension works with the Bi-State, Lincoln and North Central Local Area Working Groups.

Range Management School
Range Management School integrates sound science, collaboration and common sense to provide education on managing rangeland resources to public agency land managers, livestock permittees and other land users. Course content emphasizes sustainability and is designed to put ranchers and agency range conservationists on the same page, ensuring not only better forage available for livestock, but healthy, productive rangelands for wildlife, recreation and other uses.

Nevada Naturalist
The Nevada Naturalist Program is an adult, environmental education program created to certify education naturalist volunteers to serve in southern Nevada. The program offers two sessions of instruction created by Cooperative Extension with experts in each field of study and with full advisement and review of the partners. Session One participants complete a minimum of 60 hours of instruction in basic environmental education topics. Session Two is optional and offers more advanced topics. For each session, students are also required to complete a project on an environmental topic of their choice. Upon completion of the program, participants are certified to engage in community education programs, environmental restoration and enhancement projects, and other activities deemed necessary by the partners.

Rangeland Resources and Range Management Education
The Rangeland Resources and Range Management Education Program provides education regarding plant growth, plant response to grazing, ecological site potential, the processes of vegetation change and the role and effect of fire and other disturbances on Great Basin rangelands.

Water for the Seasons
This is a collaborative research project with the Desert Research Institute and U.S. Geological Survey. The research team is working with a diverse group of local water managers (stakeholders) to assess and simulate climate resiliency and adaptation in the Truckee-Carson River System, as a case study site representative of snow-fed dependent arid lands in the Western United States.

Living with Fire
Living With Fire is a comprehensive, multi-agency project begun in 1997 and led by University of Nevada Cooperative Extension, aimed at teaching Nevadans how to live more safely in high-wildfire-hazard environments.

Nevada Wildfire Awareness Month
Nevada Wildfire Awareness Month is a collaborative effort of Cooperative Extension's Living With Fire Program; local, state and federal firefighting agencies; and many others.

Nevada Youth Range Camp
The Nevada Youth Range Camp has been in operation for 56 years, and is a week-long camp that provides an opportunity for youth ages 14-18 in Nevada and eastern California to learn about Nevada's desert, mountain rangelands and diverse ecosystems. The courses are taught by University of Nevada Cooperative Extension and resource management professionals from state and federal agencies.

Integrated Riparian Management/Creeks and Communities

Nevada's interagency and interdisciplinary Creeks and Communities Team that teaches Riparian Proper Functioning Condition Assessment for Integrated Riparian Management has been providing education on management of riparian areas for 18 years, with their concepts leading to acceptance of and incorporation of good management principles in many cases on private and public lands.

The **Nevada Agricultural Experiment Station** (NAES) conducted the following programs to further the goals of NIFA's Climate Change, Natural Resource Management, and Environmental Science theme:

Identifying Sources of Atmospheric Ozone, Mercury, and other Trace Metals in Nevada
NAES faculty in collaboration with Teledyne Instruments developed a method to measure reactive mercury and lead isotopes. The lead isotope and concentration data collected were analyzed at Lawrence Berkeley National Laboratory. A graduate student from UNR spent several months working at this facility purifying and measuring lead concentrations and isotopes using a multi collector-inductively coupled plasma mass spectrometer. Data analyses was finalized in December 2016. Instruments were deployed at several locations around Nevada, real-time data is now being collected. In addition to lead and mercury analyses, samples are also being analyzed using scanning electron microscopy and energy-dispersive x-ray spectroscopy. This allows our researchers to see the shape of specific particles and determine their chemistry. Finally, the Weather Research and Forecasting model was run on this project over the last year. WRF is the meteorological input for the EPA's Community Multi-Scale Air Quality model, a powerful computational tool used for air quality management.

Identifying At-Risk Water and Forest Resources To Changes in Snowpack Dynamics
Over the past year, the NAES researchers have mapped a large portion of the snow ephemerality in the Great Basin. A large effort has also been focused on understanding the effects of changes from snow to rain across the Southwestern U.S., including the Great Basin. Another aspect in this project has been assessing the role of snowmelt in buffering the effects of hydrological drought in the Western U.S., also including the Great Basin. Working with hydrologists at the USDA-NRCS, the team has begun developing a procedure to include soil moisture observations in streamflow forecasting. With additional work and funding, we expect this method could be included in future streamflow forecasting across the Western U.S. The team has also developed a method to discriminate between rain and snow at the >800 NRCS SNOTEL sites across the West.

Bighorn Sheep: Genomic-Scale Perspective On Diversity And Differentiation Across The Landscape
The team of NAES scientists have continued to work with the Nevada Department of Wildlife to collect bighorn sheep samples from throughout their range in Nevada, especially in areas that our group has discovered hybridization between subspecies. The team has also refined high-throughput, genotype-by-sequencing methods to create a large single nucleotide polymorphism dataset for bighorn sheep in their native and translocated range in Nevada. By the end of this year's reporting period the team has extracted DNA from a total of 712 new samples, created genomic libraries for ~1,200 samples from unique individual sheep.

Impact of Feral Horses and Cattle on Sage Grouse Habitat
After four years of field work, investigators have measured vegetation at a total of 2,629 locations. Two graduate students and 10 technicians conducted fieldwork on Hart Mountain and Sheldon National Wildlife Refuges, and BLM lands adjacent to Sheldon NWR from March 1 through July 15. Crews captured and marked 29 new females with radio transmitters, they monitored 162 nests for a total of 608 nests over the life of the project, and sampled more than 31 miles of transects across the three study sites.

Technical improvements were made as well. A new approach for estimating survival of chicks was developed. Refinements in GIS mapping layers of the original horse and cow fecal densities now includes abundance of horses. The development of a spatial model of late brood habitat, allowing the use of this

model to assess the relationship between these habitats, which may represent local bottlenecks, and local population dynamics. Finally, the team incorporated radio age into models of survival, substantially reducing bias in survival estimates.

Building Ecological Site and Condition Based Management to a Scale Relevant for Western Land Managers
In the final year of this project using spring grazing to control weed invasion after wildfires, the team of NAES scientists apply their third winter season defoliation treatments (cattle grazing or mowing) and collect post-treatment measurements. In the spring of 2016, the team collect pre-treatment measurements and apply third growing season defoliation treatments. For the fall of 2016, the team conduct plant and soil measurements on all plots after the end of the growing season. Data analysis has begun and will continue into 2017.

Hydrologic and Vegetative Response to Pinyon-Juniper Treatment at the Watershed Scale
This project adds to an ongoing project that represents the first, fully instrumented watershed-scale research effort in Nevada. Over the past year, 92 acres of densely cover pinyon-juniper hillside was felled above Porter Canyon's meadow. For the seventh year, plant community responses to tree removal, pinyon-juniper water usage, and groundwater data are being collected. Data was collected on the green-up response of various plant communities to soil moisture and temperature difference. Additionally, a new methodology was developed to analyze the green-up data. A new layer for GIS mapping (current extent of tree remove within Porter Canyon, NV) is now available as a product.

Identifying rates and proximate controls of soil methane flux in arid ecosystems
A new field site was established this reporting period in the Desatoya Mountains, Nevada. Using five ecosystem types (playa, saltbrush dominated, sage brush dominated, meadows, and pinyon-juniper woodlands), gas samples are being collected to determine methane, carbon dioxide and nitrous oxide fluxes, along with soil temperatures, water content, surface temps, air pressure, and air temps. All of which are being conducted in the field. Soil samples are also being collected and analyzed in the lab to determine nitrogen levels, dissolved organics, and microbial species and population size. Preliminary analysis has been completed on year one's data and results indicate significant methane uptake in arid-land soils.

Post Fire Riparian Monitoring For Return of Livestock Grazing
For the third field season, the NAES team gathered field data and digital spatial data from 25 streams in eight separate fires within the Great Basin. Specifically, the team measured stream gradients, sediment size, cross sectional measurements, vegetation species composition and stream bank stability. Preparations are under way for collection and analysis of the final set of data in 2017-2018.

Sustainability of Mowing Fuel Breaks: Resilience of Sagebrush Rangelands
Data analysis was completed over the 2016 reporting and two peer-reviewed journal articles were published. Our study suggests that mowing can be beneficial. Findings indicate that sagebrush stands characterized by larger, well-spaced plants respond to mowing by favoring exotic annuals (bad). Mowing sagebrush before it reaches this late successional stage strengthen the perennial herbaceous community, and this should reduce the risks from more severe disturbances (good). Conversely, mowing sagebrush in areas with widespread cheatgrass increases cheatgrass and shift the community from woody and herbaceous to mostly herbaceous fuel composed of flammable annuals (bad).

Influences of livestock grazing and wild horse use on meadow function in sage-grouse habitat
Over the past year, twenty two field sites were established on Bureau of Land Management or US Forest Service land. The research team conducted line-point intercepts to determine species composition, percent bare ground, soil stability, wetland rating, and shrub and forb density and height. Automatic trail cameras were placed at each location and collected data in five minute intervals, during daylight,

throughout the summer months. Data has been entered into stats software and preparations of the 2017 field season are underway.

Bark Beetle Management through Biochemistry - controlling invasive forest species
Over the past year, scientists continue to expand the use of oxoplate assays to monitor cytochrome P450 activity on various substrates. These assays were/are being used to survey substrate profiles of recombinant bark beetle P450s implicated in resin metabolism and pheromone production. The team has continued dissection of the frontalin biosynthetic pathway, which acts as a pheromone or attractant in most bark beetle species, other insects, and even elephants. They also identified a pheromone-biosynthetic enzyme (CYP6DK1) using systematic lab experiments to determine the involvement of enzyme in pheromone process. Bring the total under of enzymes to five (CYP6DK1, CYP4G55, CYP4G56, CYP6DH3, and CYP6DE3) using functional assays. All five enzymes are now being cloned into a virus system which will transfer genomic material into the insect.

Transitioning from Unmanaged Rangelands to Irrigated Agricultural Affects Soil Carbon Levels
The second year of this project saw a continuation of intensive soil sampling established in year one. In addition, the team conducted particle-size fractionation analysis to measure organic carbon associated with clay, silt and sand fractions. They also performed density fractionation assays, separating out organic carbon associated with heavy and light soil fractions. After incubating surface soil samples, investigators measured microbial activity as a measure of decomposability of organic matter. They also conducted infrared spectroscopy measurements of the different soil fractions and spectroscopy data are currently being analyzed. As part of this project, the research team also tested different methods used for differentiating between soil organic and inorganic, carbonate-derived carbon.

2. Brief description of the target audience

University of Nevada Cooperative Extension target audience included:

Carson River Watershed and Floodplain Education Program: Property owners in the floodplain of the Carson River, the general public in the watershed.

Climate Change Education Workshop and Partnership: Farmers and ranchers in Nevada is the primary target audience, with the general public being a secondary target audience.

Drought-Resiliency in Small Town Groundwater Supplies: County Commissions, the town boards, and the public water supply entities in the towns that were included in the studies. These towns were Lovelock, Winnemucca, Battle Mountain, Elko, Spring Creek, Ely, Eureka, Austin, Hawthorne, Vya, Gerlach and Wadsworth.

Awareness Week and Media Campaign for Nevada Flood Hazards: The general public, schoolchildren, public officials and decision makers.

Flash Flood Education and Citizen Group: County planners and commissioners, Bureau of Land Management staff, and citizens of neighborhoods that are at risk from flash flooding.

Eagles and Agriculture: Local, state and regional public decision-makers; tourists; and the agriculture community.

Sage Grouse Conservation Facilitation: Agency representatives, private landowners and other interested/impacted entities.

Range Management School: Resource users (especially ranchers) and resource professionals.

Nevada Naturalist: Members of the general public who are interested in the natural environment.

Rangeland Resources and Range Management Education: Livestock producers, domestic and foreign agency resource management staff and administrators, policy developers, and individuals/organizations interested in rangeland resources.

Water for the Seasons: Local water managers in the Truckee-Carson River System and project scientists.

Living with Fire: Nevada homeowners living in high-fire-hazard areas.

Nevada Wildfire Awareness Month: Homeowners from fire-prone communities; and local, state, federal and private organizations with an interest in reducing the wildfire threat to Nevada communities.

Nevada Youth Range Camp: Nevada youth ages 14-18 with a serious interest in Nevada's rangelands, as evidenced by completing an application for the program and getting a letter of recommendation from an adult other than their parents.

Integrated Riparian Management/Creeks and Communities: Landowners, public land users, public interest groups, agencies and their personnel, and youth.

Nevada Agricultural Experiment Station (NAES) target audience included:

Agricultural producers and ranchers, mining industry representatives, sport hunters, environmentalists, green industry professionals, small acreage owners, general public, federal and state natural resource management agencies, and other resource managers.

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	15471	1270536	3813	129018

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	7	61	61

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Actual
2016	50

Output #2

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Actual
2016	98

Output #3

Output Measure

- Workshops, Demonstrations, and Presentations

Year	Actual
2016	444

Output #4

Output Measure

- Abstracts, Books, Book Chapter(s), Proceedings, Research Reports, and Technical Publications

Year	Actual
2016	18

Output #5

Output Measure

- Brochures, Bulletins, Fact Sheets, Newsletter, and Surveys

Year	Actual
2016	0

Output #6

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	0

Output #7

Output Measure

- Digital Media and Web Sites Created or Updated

Year	Actual
2016	11

Output #8

Output Measure

- Databases, Models, and Protocols

Year	Actual
2016	7

Output #9

Output Measure

- Leveraged research funds generated

Year	Actual
2016	2589591

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of individuals who gain knowledge about improved human, plant, and animal management systems that relate to climate change and/or natural resource use.
2	Number of clientele who implement improved human, plant, and animal management systems as related to climate change and/or natural resource use.
3	In conjunction with companion agencies and organizations, advance research in rangeland and forest management and ecology to promote advances in best management practices
4	Reduce ecological losses due to wildfires and invasive weeds that destabilize the health of Nevada's rangelands
5	Meet federal and state needs for research data related to Nevada ecosystems as the demand arises.
6	Advance research knowledge, both basic and applied, in the areas of rangeland and forest management to existing and emerging industry and consumer demand regarding genetics, biology, seed production, nutrition, and related topics.
7	Meet local groups, community, USDA, USDI, and other stakeholder demands for scientific knowledge to inform existing and emerging issues/practices in wildlife including wildlife health, human wildlife use/conflicts, and human to human conflicts related to wildlife and use.
8	Development of long-range pine nut production forecasting tool.
9	Showing the impacts of long-term management on soil organics in semi-arid pastures, meadows, and rangeland.
10	Improved monitoring of watersheds in the Great Basin
11	Protecting sensitive habitat while improving grazing opportunities
12	Changing the way we manage invasive annual weeds in the Great Basin

Outcome #1

1. Outcome Measures

Number of individuals who gain knowledge about improved human, plant, and animal management systems that relate to climate change and/or natural resource use.

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)

Climate scientists predict that rivers in the United States will produce larger and more destructive floods in the decades to come. The 2008 Carson River Regional Floodplain Management Plan, written by Carson Water Subconservancy District Staff and the Carson River Coalition and adopted by all counties in the watershed, recommends, retaining lands that provide floodplain storage, and maintain or restore connection of river with floodplain through land acquisition, conservation easements, local open space programs and other methods.

The majority of climate scientists predict that Nevada and other western states will experience more frequent and severe droughts, floods and warming temperatures in the future. As the driest state in the nation, such changes will challenge Nevada's agriculture production, human health and water supply systems. Citizens, including youth, need to prepare for and adapt to such changes.

Nevada is the driest state in the nation, and it has multi-year droughts every 15-20 years. The most recent drought began in 2012 and lasted through 2015. As part of its Hazard Mitigation Planning program, the Nevada Division of Emergency Management commissioned the Desert Research Institute to do a scientific study of groundwater aquifers used for public water supplies, and they chose Nevada Extension to deliver the information to decision makers in the rural counties and towns.

Northern Nevada has experienced major destructive floods approximately every 10 years for the past 160 years. The Carson River Watershed Regional Floodplain Management Plan recommends flood outreach education for the general public, including an annual Flood Awareness Week.

Flash floods happen in the summer from North American monsoon patterns that occasionally cause intense thunderstorms over Nevada mountain ranges. These storms can cause damaging floods to the communities at the foot of mountain canyons. There is a critical need to inform citizens about the hazards of such floods and how to prepare for them. It is also important to facilitate communication between elected officials and the residents who have been flooded.

Public understanding of the values agriculture provides our communities is critical to agricultural sustainability.
Sage grouse ecosystems are threatened by changing environmental conditions, including Pinyon-Juniper encroachments, wildfire, noxious weed invasion, unmanaged wild horse populations, urbanization, predators and recreational activities. Improvement of sagebrush ecosystem conditions across the Great Basin is critically important to all native species, and all commercial and recreational users. The issue goes beyond avoiding listing of the sage grouse as a threatened or endangered species. The true issue is maintaining multiple uses on public lands and enhancing the health of our sagebrush ecosystems.

What has been done
Nevada Extension led the effort to educate other committee members and the general public about the need to keep a broad corridor in the Carson River's floodplain free from roads, homes and other urban infrastructure. Nevada Extension worked with the U.S. Department of Agriculture Agricultural Research Service to create a collaborative partnership between Cooperative Extension and the Agriculture Research Service Southwest Regional Climate Hub in New Mexico.
Nevada Extension reported findings of a groundwater sustainability analysis completed by Nevada's Desert Research Institute to county commission meetings in Elko, Eureka, Ely, Hawthorne, Battle Mountain, Winnemucca, Lovelock and Washoe County.
Using the Nevada Floods website Nevada Extension's effort in 2016 went to help local officials plan flood awareness events in northern Nevada communities.
With regards to flash flood awareness Nevada Extension engaged a hydrologist and a geologist to present tours in a flash flood prone area. Nevada Extension produced and distributed a 21-page illustrated booklet with maps and color photos to document and explain all stops on our tour.
The Eagles and Agriculture tour is a collaborative effort to produce a safe activity to help people learn about agriculture and the benefits it provides to wildlife and the community. The program encourages the conservation and prosperity of ranching in western Nevada, teaches participants about eagle habits and the history of agriculture in Carson Valley, and creates a model of agritourism that enhances the profitability of local farming and ranching businesses.

Results
Very few new lots have been approved for development in the Douglas County and Carson City floodplains in the past six years.
A three-day workshop was held on the campus of University of Arizona Dec. 6-8, 2016. Over 60 faculty from the six states (Arizona, New Mexico, Utah, Nevada, California, Hawaii and the Pacific Territories) participated. There were speakers from all Southwest states as well as from Oregon, Colorado and Florida.
County commissioners, water utility managers, county managers and others requested copies of the analyses as a basis for planning.
With regards to flood awareness in northern Nevada, a total of 1,475 separate individuals visited the NevadaFloods.org website Oct. 1 through Dec. 1, 2016. Out of the visits, 78 percent were first-time users. Users viewed an average of 1.89 pages in each session, averaging 1 minute 26 seconds in length. The Reno Office of the National Weather Service promoted Flood Awareness Week on their popular Facebook page. These posts were liked and shared by 331 people. This resulted in a "Post Reach" for the Flood Awareness Week posts on the National Weather Service Facebook page of 5,624 people on the first day and 9,876 people on the second day of Flood Awareness Week. "Post Reach" is defined as the number of people who see the post when it is shown in their News Feed. During the entire week, 33,158 people were reached. Of those, 2,205 actually clicked on the posts to read about flooding and NevadaFloods.org.
With regards to areas prone to flash flooding, local government voted to pursue the creation of a

Stormwater Utility District, and requested and received funding to write an Area Master Drainage Plan.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
121	Management of Range Resources
122	Management and Control of Forest and Range Fires
132	Weather and Climate
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
205	Plant Management Systems
723	Hazards to Human Health and Safety

Outcome #2

1. Outcome Measures

Number of clientele who implement improved human, plant, and animal management systems as related to climate change and/or natural resource use.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

In conjunction with companion agencies and organizations, advance research in rangeland and forest management and ecology to promote advances in best management practices

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)

Sage grouse ecosystems are threatened by multiple changing environmental conditions, including Pinyon-Juniper encroachments, wildfire, noxious weed invasion, unmanaged wild horse populations, urbanization, predators and recreational activities. Improvement of sagebrush ecosystem conditions across the Great Basin is critically important to all native species, and all commercial and recreational users. The issue goes beyond avoiding listing of the sage grouse as a threatened or endangered species. The true issue is maintaining multiple uses on public lands and enhancing the health of our sagebrush ecosystems.
In Nevada, rangelands administered largely by the Bureau of Land Management and the U.S. Forest Service cover most of the state. Privately owned livestock graze much of this area, and often there is contention about what constitutes good or acceptable grazing management. University of Nevada Cooperative Extension established the Nevada Range Management School in 2005 to improve grazing management on both public and private rangelands, and to reduce conflict on the publicly administered rangelands. Many foreign countries with agriculturally based economies also struggle with application of proper range management strategies.
The Intergovernmental Panel on
Climate Change reports that the number of areas affected by drought, warming temperatures and earlier snowmelt will likely increase, adversely affecting water availability to meet the demands for agricultural and energy production, in addition to municipal, industrial, recreational and environmental water use.

Management of large-scale river systems in the western United States has taken on critical importance in the last decades due to increasing and diverse demands for water use, urban population growth and variable water supplies. Arid river systems in the Great Basin, such as the Truckee-Carson River System, that depend on spring snowmelt to supply water for agriculture, urban communities and natural resource protection, are expected to be impacted significantly by climate change.

What has been done

Nevada Extension faculty, the program?s Stakeholder Affiliate Group (12 local water managers who serve as key informants and who represent community members who rely on the river system), Desert Research Institute researchers, and members of the U.S. Geological Survey collaborated to create a modeling research design to assess and simulate climate resiliency and adaptation using the Truckee-Carson River System as a case study for land that depends on snowmelt for water in the western United States. The research team also held two invitation-only workshops with the Stakeholder Affiliate Group, and 12 structured face-to-face focus group discussions with members of the Stakeholder Affiliate Group and community members across the river system. Presentations were given to approximately 400 attendees at meetings of the National Center for Science Education and the National Science Foundation annual program director meeting. Much work was done on collecting data, testing adaptations strategies on hypothetical situations and creating models to simulate stream flows.
Nevada Extension coordinated and facilitated two meetings with the Bi-State Local Area Working Group (the group representing a sage grouse habitat spanning five Nevada counties and three California counties), four with the Lincoln County Local Area Working Group, and four with the North Central Local Area Working Group. Mono County in California contributed $5,000 to

develop a website for the bi-state sage grouse conservation. In addition, Nevada Extension participated in several Executive Oversight Committee meetings, which consisted of state and federal agency heads. At the request of the National Fish & Wildlife Foundation and Natural Resource Conservation Service?s Sage Grouse Initiative, Cooperative Extension was invited to share the Bi-State Local Area Working Groups? conservation model with the Gunnison Sage-grouse planning group in Colorado in August. Extension was also invited to share the Bi-State model on a tour of the National Association of Conservation Districts in February.
With regards to Nevada Extension's Range Management School, the program team began developing the next installment for Nevada ranchers and agency personnel to be delivered in 2017, updating the curriculum and building on past experience and ongoing research. In addition, for the third year in a row, the team was invited by the U.S. Forest Service International Programs group to teach foundational Range Management School principles for three days at an Elko County, Nev., ranch. This was part of a 14-day International Rangeland Seminar, teaching 13 agricultural and natural resource specialists from 10 foreign countries. At least seven neighboring Nevada ranchers also participated in an evening campfire social with the seminar attendees, sharing ideas on livestock and vegetation management.

Results
With regards to sage grouse conservation, the need identified at the 2015 Pinyon-Juniper Forum spurred the coordination of the Traditional Ecological Knowledge Summit conducted in June this year. The Summit resulted in the creation of a new subgroup ? the Tribal Natural Resources Committee. Now the potential for more effective working relationships has been established within the Bi-State area. Additionally, the Nevada Department of Wildlife, recognizing the effectiveness of the Local Area Working Group model, requested that Nevada Extension reestablish a working group in the central part of the state.
The Range Management School reached local, regional and international audiences.
Preliminary results from focus group sessions, targeting Stakeholder Affiliate Group participants and their associates, demonstrate medium-term project impacts. The most frequently described strategy involved enhancing water supply, followed by efforts to collect science-based information. All but one of the 12 local water managers had taken action to: improve collaboration with other local water managers; acquire science-based information on adaptation; and voice the need to modify existing prior appropriation-based water management institutions, perceived as a barrier to adaptation. Additionally, perceived adaptation barriers became more apparent as local water managers attempted to take action. That is, while only 67% of water managers who responded to this question in 2015 described adaptation barriers in general, 100% of water managers participating in focus group sessions conducted one year later in 2016 outlined barriers in detail. Barriers noted in 2016 focused on climate uncertainty or a lack of accurate forecasts of yearly snowpack and timing of snowmelt, and prior appropriation based water management institutions that lack flexibility in allowing for changes in place of use and point of diversion. Additional barriers identified included ongoing lack of coordination among key water managers, antiquated water delivery networks/infrastructure that resulted in water losses, and general water scarcity as a result of the river system?s high desert geography.

Preliminary econometric analyses show that relocation water rights can contribute to water allocation efficiency, demonstrating the potential benefits of relaxing some constraints to prior appropriated-based water rights institutions. Evidence shows that more productive or profitable agricultural lands are associated with more senior water rights, both historically and today. The results also show that, when comparing water rights that remain on initial places of use with relocated water rights, relocating water rights improves the efficiency of water allocation where the manner of use (agriculture) remains the same.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
205	Plant Management Systems

Outcome #4

1. Outcome Measures

Reduce ecological losses due to wildfires and invasive weeds that destabilize the health of Nevada's rangelands

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wildfire was one of the nine high-priority issues identified in the 1999 University of Nevada Cooperative Extension publication Natural Resource Needs in Western Nevada. The 2002-03 Western Area Cooperative Extension horticulture program needs assessment survey also identified wildfire threat reduction as a high-priority issue for the area. The PATHWAY 2007 agencies, a coalition of Tahoe Basin organizations, surveyed 1,800 individuals in 2005 and identified forest health and wildfire threat reduction as Tahoe's most important goal for the future. The Tahoe Regional Planning Agency Governing Board has identified ?Avoidance of Catastrophic Wildfire? as the top priority for the Lake Tahoe Basin. The Reno Gazette-Journal and a year-end readers? poll conducted by the Nevada Appeal both ranked ?Wildfire? as the top story of 2007. Several years of drought in Nevada, including 2012-2016, only increased the need to educate homeowners and others on vegetation management and other practices to reduce the threat of wildfire to Nevada homes and lives.

What has been done
The Living With Fire Program has been teaching homeowners how to live more safely with the wildfire threat. The collaborative program is managed by University of Nevada Cooperative

Extension. It has received numerous awards, and has been credited with spurring actions that have saved many homes. In 2016, Living With Fire materials, programs and social media were used in 12 other states, as well as in 22 countries.
Living With Fire offered multiple resources and activities statewide throughout the year, attending events to provide information, responding to requests to speak to groups, providing educational materials and assistance to other states, and conducting coordinated collaborative efforts and programs. Some of these activities include:
- Community workshops were offered at River Mount Park and Riverbend. The River Mount Park workshop had 20 participants, and the Riverbend workshop had 20 participants.
- The Nevada Network of Fire Adapted Communities promoted collaboration, communication and effective community wildfire threat reduction actions among the stakeholders in Nevada's Wildland-Urban Interface fire issue. The Network recruited community and agency members, elected an advisory board that meets quarterly, and created and distributed The Network Pulse monthly electronic newsletter. The program targets homeowners living in high-fire-hazard areas, builders, roofers, landscapers, planners and local fire service.
- Living With Fire coordinated the Nevada Wildfire Awareness Month, and the program?s involvement is discussed in the Nevada Wildfire Awareness Month Impact Statement.
- The Washoe County Wildland Urban Interface Communities Project connected communities with representatives of the local, state and federal agencies responsible for fire protection for those communities to discuss wildfire threat reduction opportunities. This project promotes networking, idea sharing, communication and improved working relationships. The project held two meetings. At the first meeting, there were 12 community members representing six communities, the U.S. Forest Service, Nevada Division of Forestry and Bureau of Land Management. Community representatives were given seven minutes to describe their community, their actions to reduce the wildfire threat and obstacles that prevent them from taking action. The agency representatives described their plans for wildfire threat reduction projects and the various forms of assistance they could provide the communities. The meeting culminated in an extensive and productive question and answer session. The second meeting was attended by 31 people representing eight communities, the U.S. Forest Service, Bureau of Land Management, City of Reno Fire Department, Truckee Meadows Fire Department and Washoe County Emergency Management. A similar format to the first meeting was used.

Results

The Bureau of Land Management recognized the Living with Fire Program. with the 2016 National Grazing Award. Oregon Department of Fish and Wildlife in conjunction with Oregon Cattlemens Association awarded the 2016 Riley Freeman Award for the work done by UNR.
- Distributed 23,093 copies of 17 different Living With Fire publications.
- There were 19,653 online visits to view 20 different Living With Fire publications and educational tools, including 459 visits to Spanish-language publications.
- Created customized materials for eight requests from five states: Arizona, Hawaii, Oregon, South Carolina and Utah.
- Provided requested general informational materials to Arizona, California, Colorado, Hawaii, Idaho, North Carolina, Oregon, South Carolina, Tennessee, Utah, Washington State and Australia.
- Presented exhibits (?I Have A Role," ?Fire Adapted Communities Pull-up" and ?Fire Adapted Communities Large Display?) at 20 events and generated 1,330 direct contacts.
- Presented The Ember House and Juniper Toss youth activities at 14 events in six Nevada counties involving 1,562 direct contacts.
- Distributed more than 2,095 promotional items (evacuation bandanas, ?Create Unity? jar grips, etc.).
- Conducted one radio interview and two television interviews.

- Living With Fire Evacuation Guidelines were included in the Elko County Frontier Phone Book.
- Print media (ads, articles, features and online) concerning the program appeared 35 times in 16 publications
- Program television PSAs aired 1,970 times.
- Program radio PSAs aired 3,960 times.
- Delivered seven wildfire threat reduction presentations to 168 individuals.
- Living With Fire Facebook page received new followers, for a total of 747 followers located in 10 Nevada counties, five states and 21 countries.
- Produced nine new blog articles.
- Produced two new YouTube videos for a total of seven.
- Collaborated with 173 entities on activities in 2016 (14 more than 2015).
- Received the Great Basin Fire Mitigation, Education and Prevention Award.

Nevada Network of Fire Adapted Communities Membership and Advisory Board met five times and gained 45 members for a total of 166, including 137 community members and 29 agency members. In addition, 11 issues of The Network Pulse electronic newsletters were produced and distributed to 605 active contacts using the Constant Contact Email Marketing tool. The Network also provided input for the ArrowCreek Homeowners Association fuels management plan; assisted Estates at Mt. Rose Homeowners Association with their ISO rating and wildfire hazard rating determination; and arranged a meeting among the Nevada Land Trust, Nevada Division of Forestry, Nevada Division of Conservation and Natural Resources, and Nevada Conservation Districts to discuss possible legislation to create special assessment districts to fund community wildfire threat reduction projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
122	Management and Control of Forest and Range Fires
205	Plant Management Systems

Outcome #5

1. Outcome Measures

Meet federal and state needs for research data related to Nevada ecosystems as the demand arises.

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)
Changing tree cover in Nevada's forests and woodlands has resulted in altered ecosystem processes at large scales including the loss of sagebrush habitat for species such as the Sage Grouse where woodlands have expanded into former sagebrush communities. Increased woodlands and tree cover have further increased the risk for extensive and high severity wildfires, putting more of the landscape at risk for cheatgrass invasion.

Despite the important role that tree cover exerts on ecosystem function, no consistent dataset exists at the statewide level for quantifying woodland cover, or for quantifying how woodland cover has changed over time. Such a dataset would be of great utility to resource managers and is relevant for a broad range of landscape planning decisions ranging from Sage-Grouse conservation to biomass utilization to managing fire and fuels.

What has been done
Scientists at the University of Nevada, Reno have developed a model for tree cover in the state of Nevada using a combination of Light Detection and Ranging (LIDAR) and Landsat data and compiled a time series spanning from the onset of modern Landsat imagery (1984) to present day and have analyzed those data for a study area in central Nevada to determine long-term trends and environmental controls on woodland expansion/densification and canopy cover loss. Our method was validated across three different study areas and showed a high degree of accuracy.

Results
Scientists at the University of Nevada, Reno have developed the most accurate model of tree cover in the state of Nevada. The model explained 79% of the variance in the data and was more accurate than the best existing tree cover model for Nevada (National Land Cover Dataset 2011). The resulting maps identify areas where woodland has been expanding, declining due to drought-related mortality, or remaining relatively stable. Predictive maps showing areas likely to experience canopy cover gain versus loss can be valuable tools to help guide science-based management of Nevada's public lands of pinyon-juniper woodlands.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
121	Management of Range Resources
122	Management and Control of Forest and Range Fires
123	Management and Sustainability of Forest Resources
205	Plant Management Systems

Outcome #6

1. Outcome Measures

Advance research knowledge, both basic and applied, in the areas of rangeland and forest management to existing and emerging industry and consumer demand regarding genetics, biology, seed production, nutrition, and related topics.

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)

Addressing the many challenges of restoring native vegetation in highly invaded, semi-arid ecosystems is too large a task for any one organization.

In Nevada, rangelands administered largely by the Bureau of Land Management and the U.S. Forest Service cover most of the state. Privately owned livestock graze much of this area, and often there is contention about what constitutes good or acceptable grazing management. University of Nevada Cooperative Extension established the Nevada Range Management School in 2005 to improve grazing management on both public and private rangelands, and to reduce conflict on the publicly administered rangelands. Many foreign countries with agriculturally based economies also struggle with application of proper range management strategies.

Many Livestock producers, domestic and foreign agency resource management staff and administrators, policy developers, land managers, and other individuals and organizations interested in rangeland resources have insufficient knowledge about the concepts of plant growth, plant response to grazing, ecological site potential, the processes of vegetation change, and the role and effect of fire and other disturbances on Great Basin rangelands. Management decisions that do not incorporate the full research base can adversely affect the range livestock industry, a suite of wildlife species, other resource attributes and local economies that depend upon access to federally administered rangelands. Many rangeland resource decisions occur at the Field Office or higher administrative levels; therefore, significant components of educational components need to be directed toward management efforts that occur at that level.

What has been done

Researchers at the University of Nevada Reno and managers at the Winnemucca, Nevada BLM District Office and have maintained a productive collaboration that has produced science-based

yet practicable guidelines aimed at improving restoration success.
For 11 years, Nevada Extension has led an interdisciplinary and interagency effort to teach the Range Management School curriculum, which emphasizes sustainability and is designed to put ranchers and agency range conservationists on the same page, ensuring not only better forage available for livestock, but healthy, productive rangelands for wildlife, recreation and other uses.

Nevada Extension has been conducting research and education on rangeland management in Nevada for at least 16 years, collaborating with colleagues; local, state and federal agencies; livestock producers; and land managers. Examples of outcomes from this work include changes in legislation with respect to wilderness study areas (Pine Forest) and their management; management goals and objectives in resource management plans developed by the Bureau of Land Management; improved interpretation of rangeland monitoring data and subsequent management decisions (e.g., Santa Rosa Ranger District letters of noncompliance rescinded) ; some changes in grazing management to decrease biomass on rangelands and decrease risk from catastrophic fires; development of risk assessments for 18 sage grouse population management units; and publication of 14 eXtension papers in 2012.

Results
This collaboration has resulted in a simple and rapid method of evaluating and selecting appropriate sources of native seed based on relatively short-term survival and growth under the same kinds of conditions as those encountered during restoration. Additionally, collaborations have identified and demonstrated new opportunities for restoration in exceptionally challenging areas where few options remain. These examples illustrate the value of research-friendly management and management-friendly research in responding to some of the challenges of wildland restoration.
The program team began developing the next installment for Nevada ranchers and agency personnel to be delivered in 2017, updating the curriculum and building on past experience and ongoing research. In addition, for the third year in a row, the team was invited by the U.S. Forest Service International Programs group to teach foundational Range Management School principles for three days at an Elko County, Nev., ranch. This was part of a 14-day International Rangeland Seminar, teaching 13 agricultural and natural resource specialists from 10 foreign countries. At least seven neighboring Nevada ranchers also participated in an evening campfire social with the seminar attendees, sharing ideas on livestock and vegetation management.
Nevada Extension held five project workshops teaching land managers ?How to Determine the Most Appropriate Treatments Before and After a Wildfire in Sagebrush and Pinon-Juniper Ecosystems? reached 153 attendees across four states. The ?Right Seed in the Right Place at the Right Time? webinar series was attended by 621 original viewers and had 1,164 subsequent views of the archived webinars. Ninety-five percent of survey respondents stated ?these webinars applied to their work?, and 79% said ?I can apply these concepts to my work today? and ?will change my approach to fire, fuels and vegetation management.? The collective evidence strongly suggests this project is accomplishing its goal of putting important peer-reviewed science in the hands of land managers.
Multiple attendees of the two conferences held to demonstrate the difference between surface water availability and water needed by rangeland plants requested copies of the presentation, including the director of the U.S. Forest Service Western Wildland Environmental Threat Assessment Center.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
121	Management of Range Resources
122	Management and Control of Forest and Range Fires
205	Plant Management Systems

Outcome #7

1. Outcome Measures

Meet local groups, community, USDA, USDI, and other stakeholder demands for scientific knowledge to inform existing and emerging issues/practices in wildlife including wildlife health, human wildlife use/conflicts, and human to human conflicts related to wildlife and use.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Development of long-range pine nut production forecasting tool.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Pine nut is a gourmet non-timber forest product. Pine nuts are harvested in natural stands and plantations in many regions of the world. In the U.S., however, the commercial importance of this product is underestimated. As a result, natural stands of pine nut producing pinyon pines in the U.S. are not specifically managed for pine nut production. Concurrently, over 80% of pine nuts consumed in the U.S. are imported. With the fast growing domestic demand in China and Russia, the largest producers of pine nut consumed in the U.S., and the extensive destruction through logging of pine nut producing forests of Siberia and Northeast China?s Jilin Province, the U.S. may no longer rely on imports to meet local demand. The worldwide scarcity of pine nut supply calls for a re-evaluation of the economic and ecological significance of pinyon pine forests and for

considering growing pine nut producing pines in horticultural / agroforestry / forestry settings.

What has been done
Researchers from the University of Nevada, using pinyon pine woodlands found in the Great Basin, they estimated historical reproductive outputs by counting abscission scars (a mark on branches when the female cone drops). Here the team uses a long-term dataset of cone abundance on individually monitored pinyon pine trees to validate the cone abscission scar methodology. The cone scar method provides a promising approach to estimate seed cone production over the past 10?20 years among several pine species.

Results
Long-term, historical data on tree seed production are needed to predict how tree population dynamics will be affected by changing climate and land-use practices, which may dramatically alter forest and woodland ecosystems.

This information can be used to develop long-range pine nut forecasts and to assess how seed production may change under a changing climate. Furthermore, land managers can use this approach to determine which trees have high reproductive outputs in an area.

If for instance, the management goal is to retain large seed producing trees for pine nut harvesters, then land managers can use these data to identify those trees to remain on the landscape following fuel-reduction treatments.

Overall, this method provides a robust and time efficient approach to accurately determine historical annual cone production, data that are critically important to determine the drivers of seed production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
123	Management and Sustainability of Forest Resources

Outcome #9

1. Outcome Measures

Showing the impacts of long-term management on soil organics in semi-arid pastures, meadows, and rangeland.

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)
Arid and semi-arid regions cover about 40% of the earth's surface. These areas have experienced major land use changes, including conversion to agricultural lands and development of large urban centers. It is however, unclear if arid lands can act as a source or sink for atmospheric CO2 and how source/sink behavior may be affected by changes in land use. The objective of this study involving soils and plant science was to determine how transitions from unmanaged rangelands to irrigated agricultural use affects carbon storage in soils.

What has been done
The study showed that alfalfa fields tend to act more as a source of CO2 than a sink, while just the opposite is occurring in native vegetation like rabbit brush. Whether by roots respiration or microbial activity, alfalfa is changing the CO2 continent amount and availability quicker than native plants. Our results show that conversion of native vegetation to alfalfa lowers soil organic matter content and will decrease the decomposability of the organic matter. Overall, belowground biological activity increased when native vegetation was converted to alfalfa, but this increase was most likely primarily due to increased root respiration of the crops rather than microbial decomposition of organic matter.

Results
This research represents the first study conducted in semi-arid lands showing the impacts of long-term management on soil organic matter fractions using a variety of fractionation techniques in combination with advanced chemical and isotopic analyses.

The team also showed that some common methods used for differentiating between soil organic and inorganic carbon do not always provide accurate determination of quantity and isotopic composition of soil carbon.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
205	Plant Management Systems

Outcome #10

1. Outcome Measures

Improved monitoring of watersheds in the Great Basin

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)
The plant communities seasonal changes is recognized as important for ecological dynamics. There has been a recent use of phenology and camera networks worldwide. The established PhenoCam Network has sites in the United States, including the western states. However, published research from semi-arid regions is lacking. In this study, our team of AES and USDA-ARS scientists demonstrate the utility of camera-based repeat digital imagery and use of R statistical phenopix package to quantify plant green-up and die-back in four plant communities in the semi-arid cold desert region of the Great Basin.

What has been done
The team developed an automated variable snow/night filter for removing short-lived snow events. Thus, were able to detect low amplitude seasonal variation in pinyon- juniper canopies and sagebrush steppe, and characterize wet and semi-dry meadows. Using individual pixel-based spatial analyses to separate sagebrush-shrub canopy pixels from interspace by determining differences in annual cycles of sagebrush relative to interspace.

Results
The ability to monitor plant phenology with camera-based images fills spatial and temporal gaps in remotely sensed data and field based surveys, allowing species level relationships between environmental variables and phenology to be developed on a fine time scale thus providing powerful new tools for land management.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water

112	Watershed Protection and Management
122	Management and Control of Forest and Range Fires
132	Weather and Climate
205	Plant Management Systems

Outcome #11

1. Outcome Measures

Protecting sensitive habitat while improving grazing opportunities

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Land managers often face the dilemma of balancing livestock use with conservation of sensitive species and ecosystems. For example, most of the remaining vernal pools in California are grazed by livestock. Vernal pools are seasonal wetlands that support many rare and endemic species, such as slender Orcutt grass. Slender Orcutt grass is listed as "threatened" by the US Fish & Wildlife Service. Although studies in other areas of California have demonstrated that livestock use may benefit some vernal pool specialist species, grazing has been considered a hazard to slender Orcutt grass in northeastern California.

What has been done
The University of Nevada, Reno research team evaluated the effects of livestock use on slender Orcutt grass using a replicated, paired design across a range of environmental conditions and grazing management regimes. Frequency, density, cover, reproductive potential, and height of slender Orcutt grass was compared in plots where livestock had been excluded with plots where grazing occurred.

Results
We found no evidence that livestock consume slender Orcutt grass. Our results show that land managers can balance the needs of sensitive vernal pool habitats and species with the maintenance of livestock utilization on public lands. Despite the fact that livestock do not graze slender Orcutt grass directly, our results suggest that livestock use can still have important indirect effects on this species. The team found declines in slender Orcutt grass frequency,

density, cover and reproductive potential over time after exclusion from livestock use. Reduction of litter in unfenced plots was associated with increased frequency, density, cover, and reproductive potential of slender Orcutt grass.

A grazing management plan that is compatible with the conservation of slender Orcutt grass populations should incorporate information concerning annual variability (including patterns of precipitation and productivity), season of grazing, and type of livestock. Managers might increase AUM in years when vernal pool plant productivity is high because livestock use can benefit slender Orcutt grass by reducing litter cover.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
136	Conservation of Biological Diversity
205	Plant Management Systems

Outcome #12

1. Outcome Measures

Changing the way we manage invasive annual weeds in the Great Basin

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
For the past ten years, researcher at the University of Nevada, Reno have shown the positive environmental changes that have come from late season grazing on pastures dominated by Eurasian annual grasses - cheatgrass and medusahead. The annual grass component must be recognized and factored into grazing systems in order to positively change these plant communities from annual dominance to perennial dominance. When applied at landscape scales late season grazing can effectively reduce wildland fire risk and hazard, while also improving habitat for wildlife and forage for livestock.

What has been done

NAES scientists continued to implement and monitor three fall cheatgrass grazing demonstration projects in Oregon and Nevada and spent a great deal of time/effort implementing three additional landscape scale projects, 25-30,000 ac project in Jordan Valley, OR, 30,000 ac project in Skull Valley, UT, and 30,000 ac project at Imlay, NV. All three new projects are in cooperation with Bureau of Land Management State Range Staff. Two new research project have also begun. In cooperation with Oregon State University and USDA-Agricultural Research Services a 30,000 acres project focused on late-season grazing on cheatgrass/medusahead has been launched. In Utah, USDA-ARS and Utah BLM are beginning a 30,000-acre project to control a cheatgrass dominated allotment.

Results

Results from several research and demonstration projects in Nevada and Oregon have led to increased awareness of this range management tool, and a growing desire to apply the practice on similar lands in other Great Basin states, Idaho and Utah. This work is leading to a paradigm shift in thinking and grazing treatments when land managers encounter a mix of perennial and annual grasses on a given allotment.

In Oregon, the Drewsey Field Ranch saved $50/head/month by not having to feed high-priced hay October - January. Running 400 head of cattle on their BLM allotment, the owners saved over $80,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
121	Management of Range Resources
122	Management and Control of Forest and Range Fires
205	Plant Management Systems
307	Animal Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Drought is always a challenge in arid system restoration, and drought limited both our seed collection and survival in our common gardens. However, the extremely strong selection seedlings experienced throughout this project may actually have increased our ability to detect differences among populations, and thus this factor may have been positive.
Initial graduate student assigned to the methane flux project withdrew. A technician filled in briefly during spring 2016 and assisted in identification of sites. New graduate student

began in summer 2016 and required extensive training. This delayed is forcing AES scientists to reconsider the overall scope of the project.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Nevada Agricultural Experiment Station (NAES) results are as follow:

Research into point-sources of ozone, mercury and lead in the atmosphere has fostered the collaboration of the AES team and Teledyne Instruments to produce a new method of measuring reactive mercury and lead isotopes and numerous types of particulate matter.

Working with hydrologists at the USDA-NRCS, the AES team has begun developing a procedure to include soil moisture observations in streamflow forecasting. With additional work, we expect this method could be included in future streamflow forecasting across the Western U.S. The team has also developed a method to discriminate between rain and snow at more than 800 USDA-NRCS SNOTEL sites across the West. Both this method have the potentially to be useful to resource managers.

The development of high-throughput sequencing and bioinformatics for use in extremely high-value bighorn sheep is having profound effects on the number of additional labs (both inside and outside of UNR) having the tools to transition to genome-scale data generation, even in non-model systems.

Work conducted across the Hart and Seldon National Wildlife Refuges, plus the Massacre-Vya Population Management Unit on wild horse, cattle and sage grouse has identified overgrazed meadows as targets for conservation actions by the NRCS and BLM.

In our pinyon-juniper watershed research, we demonstrate the utility of camera-based repeat digital imagery and use of R statistical phenopix package to quantify plant green up and die back in four plant communities in the semi-arid cold desert region of the Great Basin.

The Bureau of Land Management (BLM) was recently tasked with a project to explore the use of strategic targeted grazing to reduce fine fuels. They have taken the research conducted at the University of Nevada and started applying the same treatments to both the Vale, OR and Battle Mountain, NV Districts to continue exploring the ramification of grazing cattle in the spring time to reduce cheatgrass and other invasive weeds.

University of Nevada Cooperative Extension results are as follow:

After 13 years of work to educate the general public about the functions and values of floodplain lands and the importance of protecting them, there is evidence of growing awareness of the value and function of floodplains. The Douglas County Lands Bill, passed by the United States Congress in 2014 noted that its "primary goal is to permanently protect its essential floodplains, open space, natural resources, rural character, and cultural heritage through the acquisition of conservation easements on Douglas County's historic agricultural operations." The protection of natural floodplains is the principal recommendation of the Regional Floodplain Management Plan, which was developed in part through efforts supported by Nevada Extension, and is the main message of the Carson

River Coalition.

A three-day workshop was held on the campus of University of Arizona Dec. 6-8, 2016. Over 60 faculty from the six states (Arizona, New Mexico, Utah, Nevada, California, Hawaii and the Pacific Territories) participated. There were speakers from all Southwest states as well as from Oregon, Colorado and Florida. The consensus by the third day was that all represented Cooperative Extension programs would contribute to the partnership with the goal of building Extension's capacity to convey climate science education at the local level. One climate science expert wrote that this workshop was "the most significant event and partnership I have been a part of in my 10 years of work in climate change." Another wrote, "One of the best if not the best organized and focused workshops I have participated in for a long time!"

As a result of Proper Functioning Condition classes in Nevada, the Environmental Protection Agency has embraced Proper Functioning Condition as a fundamentally useful tool for improving water quality. They have taught Proper Functioning Condition to numerous tribes in California and Arizona and hosted regional Proper Functioning Condition class in Las Vegas. Tribes mentored about Proper Functioning Condition report that they finally understand connections between water quality, which they are required to monitor, and land and water management, which through Proper Functioning Condition can be more widely appreciated among tribal members. Proper Functioning Condition concepts are being integrated into numerous Environmental Protection Agency publications and outside publications with lead authorship by Agency personnel in collaboration with Cooperative Extension.

Riparian Proper Functioning Condition is increasingly becoming recognized as a fundamentally important focus for sage grouse conservation, especially on private lands because late brood rearing habitat is often limiting. Proper Functioning Condition will now be an important focus for projects to mitigate human-caused impacts, partly due to the wide acceptance of Proper Functioning Condition concepts that Extension and this team has been championing for the past 18 years.

The Nevada Creeks and Communities Team received the Soil and Water Conservation Society's 2016 Merit Award. The award recognized the team's work in educating Nevada communities about assessing and maintaining riparian areas with classes on how plants, soil/landform and water should work together in riparian areas; how to identify what's not working; and how to fix it.

Nevada Extension's leader of the Nevada Flood Awareness Week received the Joint Council of Extension Professionals Award for Creative Excellence. This award is granted to Cooperative Extension individuals or small teams who address emerging or existing issues in novel ways that get results, and that others want to emulate. He was chosen out of seven national finalists, who were selected from several regional nominees. In the past 25 years, he has addressed watershed management, efficient water use, safe drinking water, protection of Lake Tahoe's water quality, public water policy, flash flooding, floodplain management, environmental literacy, environmentally friendly home landscaping, and the need for trained landscapers and training Hispanic workers.

For the Water for the Seasons project, preliminary results from focus group sessions, targeting Stakeholder Affiliate Group participants and their associates, demonstrate medium-term project impacts. The most frequently described strategy involved enhancing

water supply, followed by efforts to collect science-based information. All but one of the 12 local water managers had taken action to: improve collaboration with other local water managers; acquire science-based information on adaptation; and voice the need to modify existing prior appropriation-based water management institutions, perceived as a barrier to adaptation. Additionally, perceived adaptation barriers became more apparent as local water managers attempted to take action. That is, while only 67% of water managers who responded to this question in 2015 described adaptation barriers in general, 100% of water managers participating in focus group sessions conducted one year later in 2016 outlined barriers in detail. Barriers noted in 2016 focused on climate uncertainty or a lack of accurate forecasts of yearly snowpack and timing of snowmelt, and prior appropriation based water management institutions that lack flexibility in allowing for changes in place of use and point of diversion. Additional barriers identified included ongoing lack of coordination among key water managers, antiquated water delivery networks/infrastructure that resulted in water losses, and general water scarcity as a result of the river system's high desert geography.

Key Items of Evaluation

Nevada Agricultural Experiment Station "Key Items" as follow:

- Work conducted across northwestern Nevada and southeastern Oregon on wild horse, cattle and sage grouse has identified overgrazed meadows as targets for conservation actions by the NRCS and BLM.
- Developed a powerful new tool for land managers needing to monitor plant seasonal changes using camera-based images.
- Bureau of Land Management is using data on controlling cheatgrass and other invasive weed on western rangelands by grazing cattle during spring green up, to reduce seed banks, pounds per acre, and continuity.
- Introduced a new tool in forecasting harvest numbers in the pine-nut industry
- Predictive maps showing areas likely to experience canopy cover gain versus loss is a valuable tools to help guide science-based management of Nevada's public lands of pinyon-juniper woodlands.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Sustainable Energy

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		20%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		60%	
204	Plant Product Quality and Utility (Preharvest)	0%		6%	
206	Basic Plant Biology	0%		8%	
511	New and Improved Non-Food Products and Processes	0%		6%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	1.5	0.0
Actual Paid	0.0	0.0	1.8	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**
0	0	243347	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	223034	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

The **Nevada Agricultural Experiment Station** (NAES) conducted the following programs to further the goals of NIFA's Sustainable Energy theme:

Prickly Pear Cactus a Novel Biofuel Feedstock - Molecular
A big break through this year was the development of novel constructs (DNA from different sources) containing embryogenic transcription factors WUSCHEL and BABYBOOM to transform Prickly Pear Cactus (O. ficus-indica). Utilizing these constructs, preliminary confocal images indicate increased lipid content in transformed cactus pads (cladodes) compared to control transformants.

Our researchers continued to develop genomic resources for octoploid Prickly Pear Cactus, including the sequencing of the diploid, sister species Nopal Cactur (Opuntia cochenillifera). Nopla has a lower ploidy than the agriculturally significant Prickly Pear, allowing the diploid genome of this model species to be used as a scaffold that will help in the assembly of Prickly Pear genome and transcriptome. To date, a total of 67 PacBio SMRT cells have been sequenced resulting in 22X coverage of the genome, a scaffold of 667 Mb, and an N50 = 192 kb. Additional PacBio sequencing is ongoing and is needed to produce a high-quality genome assembly.

To produced improved transcriptome data from octoploid Prickly Pear Cactus (O. ficus-indica), including sequencing a developmental gradient of cactus pads and fruit using state-of-the-art PacBio IsoSeq technology. For cladodes and fruit, a total of 37 Single Molecule Real-Time (SMRT) cells were sequenced, generating over 1.3 M full-length reads from three different size libraries (1-2 kb, 2-3 kb, and 3-6 kb). The long reads produced from this method is providing high-quality data for current and previously sequenced samples. The major advantage of the PacBio IsoSeq method is that full-length cDNA sequences are obtained and avoids the creation of chimeric (false) assembly products relative to short-read cDNA sequencing approaches.

Prickly Pear Cactus - Propagation
Pads (cladodes) of the three different species of Prickly Pear Cactus (Opuntia ficus-indica, O. cochenillifera, and O. streptacantha) under evaluation continue to be expanded by vegetative propagation under greenhouse conditions to provide adequate replacement pads for the field trial. For the second consecutive year, pads from the field site in Logandale, NV were harvested in January 2016. Fruits were harvested on July 2016. Data was collected on fresh and dry pad biomass, pad counts, both fresh and dry fruit biomass, and fruit counts.

Camelina (false flax): a new biofuel and forage for Nevada
Progress has been made in developing and testing new traits to improve the yield, oil quality, and stress tolerance of Camelina sativa. A proof-of-concept experiment was published in which tissue succulence was engineered in the model plant Arabidopsis thaliana by overexpression of traits found in wine grape. Preliminary results suggest that some of the expected CEB-dependent enhancements observed in Arabidopsis can be achieved in Camelina. The stability of these traits are continuing to be investigated.

Experiment Station labs have identified several low seed mucilage Camelina lines. A low mucilage trait improves the processing of Camelina as a biofuel feedstock. Our labs have identified three high-oil mutant plant lines. Compared to wild-type seeds having ~29% oil, the mutants show nearly 1.4-fold increases to between 41 and 45%. The stability of these and other traits are continuing to be investigated.

The Harper lab used a CRISPR/Cas9 editing strategy to disrupt Fatty Acid Desaturase II to create transgenic Camelina with an oil quality more suitable for biofuels (~ 6-fold less C18:2, 2-fold less C18:3).

Additional CRISPR/Cas9 experiments are in progress to make plants with less erucic acid (monounsaturated omega-9 fatty acid, 22:1ω9), and less glucosinolates.

Camelina and Arabidopsis seeds engineered for high thiamine and high thiamine pyrophosphate showed increased germination and seedling survivability rates when grown under high salt and oxidative stress. The stability of these and other traits are still under investigation.

Assessing the oil, protein and carbohydrate levels in high thiamine seed, our finding suggest that third generation transgenic Camelina engineered for high thiamine seed contained more oil and carbohydrate, but less protein, than wild type Camelina seed. However, the thiamine content of T4 transgenic Camelina seed was lower. These results suggest that the high thiamine transgenic trait might not be stable.

Field trials also continued, conducted three field experiments to: 1) Determine the seed yield of five selected Camelina sativa accessions in response to three different irrigation regimes. 2) Determine the seed yields as a function of planting method and time of planting. 3) determine the Nitrogen rate and source effects on Camelina seed yield and biomass production.

Curly Top Gumweed Biofuel Potential
Having determined how to extract 72% of the biocrude from gumweed through methylization, other methods of extraction were examined. Catalytic conversion/decarboxylation/hydrogenation of the carboxylic acid components as well as simple pyrolysis of the biocrude under reducing conditions were tested. Lowering the oxygen content of the resulting biofuel to produce a compatible jet fuel is particularly attractive, and the preliminary results are promising.

In addition to production of a biofuel, the extracted material (bagasse) was examined as a feed component. Even though nutritional analysis and feeding trials are still being conducted, moderately high crude protein content were detected (7.7 to 10.8%). Another potential use of the extracted bagasse that is currently being investigated is as a fuel component that when treated with hydrothermal carbonization processes could be used for power generation at the point of consumption.

2. Brief description of the target audience

Nevada Agricultural Experiment Station (NAES) target audience included:
The scientific community at national and international scientific meetings, specifically to research scientists and undergraduate and graduate students and post-doctoral researchers conducting research on alternative crops for arid lands. Also included are the general public, energy and chemical industry, and potential producers.

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	0	0	0	0

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	4	4

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Actual
2016	13

Output #2

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Actual
2016	22

Output #3

Output Measure

- Workshops, Demonstrations, and Presentations

Year	Actual
2016	6

Output #4

Output Measure

- Abstracts, Books, Book Chapter(s), Proceedings, Research Reports, and Technical Publications
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Brochures, Bulletins, Fact Sheets, Newsletter, and Surveys
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- Manuals and Other Printed Instructional Materials Produced
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Digital Media and Web Sites Created or Updated

Year	Actual
2016	3

Output #8

Output Measure

- Databases, Models, and Protocols

Year	Actual
2016	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of individuals who gain knowledge about sustainable energy and environmentally responsible lifestyles.
2	Number of individuals who implement practices related to or in support of sustainable energy and environmentally responsible lifestyles and practices.
3	Programs in this area will develop strategies to engage producers, industrial partners, and consumers groups resulting in effective leadership-oriented partnerships.
4	Annually the program will report, in conjunction with industrial partners, non-proprietary research gains made to the consuming public to garner interest in adoption of new products and processes when released.
5	Increased understanding of energy alternatives, resources and project support.

Outcome #1

1. **Outcome Measures**

   Number of individuals who gain knowledge about sustainable energy and environmentally responsible lifestyles.

   Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

   Number of individuals who implement practices related to or in support of sustainable energy and environmentally responsible lifestyles and practices.

   Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

   Programs in this area will develop strategies to engage producers, industrial partners, and consumers groups resulting in effective leadership-oriented partnerships.

   Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

   Annually the program will report, in conjunction with industrial partners, non-proprietary research gains made to the consuming public to garner interest in adoption of new products and processes when released.

   Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

   Increased understanding of energy alternatives, resources and project support.

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)
Acid drainage remains the largest source of environmental pollution from mining in the western United States. The University of Nevada, Reno has been treating acid mine drainage from the Leviathan mine, a Superfund site in the Sierra Nevada mountains, since 1993. A system of four constructed ponds serves as a bioreactor treatment system that converts acid in mine water using sulfate-reducing bacteria and ethanol to promote the precipitation of dissolved metals. The cost of ethanol is a major factor in the operational costs of alcohol-fed bioreactors. This study was initiated to determine if low cost biodiesel waste could serve as a carbon source.

What has been done
Two laboratory column studies were conducted. The first compared columns fed biodiesel waste with columns fed laboratory-grade glycerol to determine if any material in biodiesel waste negatively impacted sulfate reduction. The second compared columns fed biodiesel waste with columns fed ethanol, and how columns then reacted to switching carbons to determine how our field bioreactor might react to having ethanol replaced with biodiesel waste.

Results
The fluid left after production of biodiesel fuel, is becoming a disposal issue as more biodiesel is manufactured. Semi-passive bioreactors treating acid mine drainage waters may be able to use the waste from biodiesel production as a food source for sulfate-reducing bacteria cultivated for use in reactors. Thus involving one waste material in the remediation of another. Biodiesel waste shows strong evidence of being a very good material for use in bioreactors that utilize sulfate-reducing bacteria. Although a reactor operating on ethanol may take time to transition fully to biodiesel waste, it is an inexpensive waste material that provides a complex carbon source, and is potentially utilized more fully than ethanol.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Other (Complex nature of molecular biology)

Brief Explanation

Prickly Pear Cactus (Opuntia) transformation remains challenging. However, we remain optimistic that the new novel constructs containing the embryogenic transcription factors WUSCHEL and BABYBOOM will result in the successful transformation of polyploid Opuntia, that is, containing four homologous sets of chromosomes).
The major problem we have faced is Opuntia lodging (falling over) as the plants have grown taller in water supplement trials. Some plants were toppled by major wind events - 75% toppled plants were at high irrigation rates.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The ongoing full-length cDNA sequencing using the PacBio IsoSeq platform is providing a near complete transcriptome for Prickly Pear Cactus (Opuntioa ficus-indica), resolving multi-gene families and should prove useful for the exploration of the genetic basis of genetic traits such as cladode (pad) outer coating of wax formation and fruit color.

New information about the effect of irrigation levels on Opuntia biomass and fruit production in a field setting in the U.S. was gathered. Information about the selection of the best species or cultivars of Opuntia to use for biomass and fruit production has also been gained. New information about the rate of increase in Opuntia biomass or fruit production over time in a field setting in the U.S. was also gathered.

Key Items of Evaluation

Developed a potentially novel transformation method for Prickly Pear Cactus (Opuntia) using WUSCHEL and BABYBOOM transcription factors that does not rely on antibiotic selection, but rather the production of embryos in culture.

Developed a protocol for producing highly purified Opuntia nuclear DNA for use in genomic sequencing.

Developed a protocol for successful transient transformation of Opuntia using biolistic bombardment.

Developed a protocol for successful transient transformation of Opuntia using agroinfiltration.

A proof-of-concept experiment was published in which tissue succulence was engineered in the model plant Arabidopsis thaliana by overexpression of traits found in wine grape.

We have identified several low seed mucilage Camelina lines. A low mucilage trait improves the processing of Camelina as a biofuel feedstock.

Identified three high-oil mutant plant lines showing a 1.4-fold increase over normal camelina lines.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Childhood Obesity, Nutrition, and Health

☑ 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
702	Requirements and Function of Nutrients and Other Food Components	0%		75%	
703	Nutrition Education and Behavior	73%		0%	
704	Nutrition and Hunger in the Population	27%		0%	
722	Zoonotic Diseases and Parasites Affecting Humans	0%		25%	
	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	3.0	0.0	0.2	0.0
Actual Paid	0.9	0.0	1.3	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**
141514	0	112121	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	130560	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

University of Nevada Cooperative Extension conducted the following programs to further the goals of NIFA's Childhood Obesity, Nutrition, and Health theme:

Veggies for Kids is an in-school program that teaches youth how to grow vegetables and about nutrition by providing a 10-week series of one-hour lessons in the classroom, a four-day summer institute, and a specialty crop demonstration project at the school. Veggies for Seniors is an expansion of the Veggies for Kids Program and Mineral County garden demonstration project. The demonstration project consists of a 42-foot and a 84-foot hoop house behind Hawthorne Elementary School and an outside garden. The program provides fresh fruits and vegetables for Mineral County seniors with disabilities.

Little Books and Little Cooks is a seven-week early literacy and parenting education program (two hours each week) for preschool-age children (3-5 years old) and their parents. During the program, children and parents come together to learn about healthy eating and nutrition, gain positive parent-child interaction skills, and practice school readiness skills by reading children's books about healthy eating/nutrition and cooking/eating every week.

The **Nevada Agricultural Experiment Station** (NAES) conducted the following programs to further the goals of NIFA's Childhood Obesity, Nutrition, & Health theme:

The Role of Natural Food Epigenetic Regulators on Obesity-Mediated Cardiac Enlargement and Stiffing
Being a new line of research at the University of Nevada, Reno, plate readers, reagents and associated tools were obtained. The epigenetic regulator, histone deacetylases (HDAC), activity assay was optimized with newly purchased substrates (classes II & III) and reagents. The team also synthesized a non-commercially available class I substrate. Once optimization was completed, 131 bioactive food compounds were screened for HDAC inhibitors in cardiac tissue. From this screen, the team identified 18 bioactive compound HDAC inhibitors. Using mouse cardiac muscle cells, the team tested the 18 bioactive compounds to determine if DNA transcription was improved - HDAC's interfere with transcription.

Training has begun (1 undergrad, 1 MS/BS, and 1 Ph.D. student) in the preparation of neonatal rat ventricular cardiac myocytes. The students have begun screening the 18 bioactive food compounds to determine if these inhibitors block cardiac enlargement.

Beneficial and Adverse Effects of Grape Seed Extract (GSPE) on Human Health
The Experiment Station investigation team has fractionated GSPE to determine the component within the extract that exerts the co-antagonistic effects with respect to bile acid bound FXR (which up- or down-regulates the expression of certain genes). The team also isolated 25 fractions and performed transient transfection studies to determine their ability to enhance bile acid bound FXR transactivation and characterized the positive fraction by mass spec analysis.

Using rodent models, the team has determined that GSPE effects on intestinal bile acid transporters functions as a new mechanism that leads to triglyceride-lowering effects in humans. This is an important finding indicating the importance of the gut-liver connection in the molecular actions of GSPE.

The team has also discovered that GSPE acts as an HDAC inhibitor and in so doing increases the ability of the nuclear receptor (working with other proteins, regulate the expression of specific genes) to increase target gene expression, thereby leading to increased protection against insulin resistance, ultimately contributing to reduced triglyceride levels following GSPE administration.

Finally, the team determined that GSPE provides additive and complementary efficacy as a lipid-lowering combination therapy with the bile acid sequestrant cholestyramine in rodents by lowering liver cholesterol synthesis, enhancing bile acid biosynthesis and decreasing metabolic formation of fat.

Potential Beneficial Health Effects of Grape Seed Extracts (GSPE) from Nevada Grown Grapes Seeds
The team assessed the ability of extracts isolated from the Nevada grown seeds raised under drought stressed and well-watered conditions for their antioxidant capacity and their ability to enhance bile acid-bound FXR transactivation in vitro. In order to determine why GSPE enhances bile acid bound FXR activity, the team fractionated GSPE using chromatography and collected 25 fractions per run. Each fraction was tested in the transient transfection assay system to determine which fractions enhanced bile acid-bound FXR transactivation. The fractions that consistently demonstrated enhanced FXR transactivation from each run were sent for mass spec analysis, along with a sample of the whole GSPE and each of the extracts prepared in-house. Studies are currently on-going to test the ability of the fractions of GSPE found to enhance transactivation of FXR for their ability to regulate FXR target-gene expression in a continuous cell of heterogeneous human epithelial colorectal cells.

Rodents Role in Maintaining the Tick-Borne Disease "Relapsing Fever" in Nature
Research and field collections have continued in this last year of the project. Prevalence of Borrelia hermsii, the pathogen that causes tick-borne relapsing fever, in the small mammal populations was similar to previous years. However, unlike other years in which this study has been performed, in 2016 a much higher than normal number of human cases of the disease were identified. Multiple outbreaks of human TBRF were reported throughout the eastern Sierra Nevada range and in southern California. The investigators have worked with effected homeowners and state and county public health personnel to help identify infected small mammal hosts around their property, search for the soft tick vectors in their cabins and detect areas in their homes/cabins that small mammals use to gain access inside and thereby expose the human inhabitants to the infected soft tick vectors. Investigators have found out firsthand how poorly educated the medical communities in northern Nevada/eastern California are regarding this particular disease. From this past year's activities, it has become apparent how insensitive the current diagnostic tests are for this disease and we plan to work with other researchers to develop a new diagnostic tool that could more accurately diagnose this disease in a timely manner.

2. Brief description of the target audience

University of Nevada Cooperative Extension target audience included:

Children kindergarten through third grade in low-income rural Nevada communities, and Mineral County seniors with disabilities. Children ages 3-5 and their parents, with a focus on lower-income families, ethnically diverse families, children in Head Start, and children to attend at-risk schools.

Nevada Agricultural Experiment Station (NAES) target audience included:

Consumers, health care personnel, agency personnel, nutrition support groups, state and county public health and vector control agencies.

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	9096	0	12533	0

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	6	9

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Actual
2016	14

Output #2

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Actual
2016	10

Output #3

Output Measure

- Workshops, Demonstrations, and Presentations

Year	Actual
2016	22

Output #4

Output Measure

- Abstracts, Books, Book Chapter(s), Proceedings, Research Reports, and Technical Publications

Year	Actual
2016	2

Output #5

Output Measure

- Brochures, Bulletins, Fact Sheets, Newsletter, and Surveys

Year	Actual
2016	0

Output #6

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	0

Output #7

Output Measure

- Digital Media and Web Sites Created or Updated

Year	Actual
2016	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of individuals who gain knowledge about nutrition and health.
2	Number of individuals who implement behaviors to improve health and nutrition.
3	Apply new knowledge to programs at the field level with a goal of significant long term weight loss and overall improvement of health in those who participate.
4	To identify research activities such as new data sources, improved techniques for data analysis, and improved hypotheses for obesity research questions.

Outcome #1

1. Outcome Measures

Number of individuals who gain knowledge about nutrition and health.

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)
Children and senior citizens are below the national average in consuming the daily recommended amounts of fruits and vegetables. According to the U.S. Census, 24% of the Mineral County population is 65 years and older, and 18% of the population is under the age of 18. For many children, academic difficulties begin before they start school. In a national survey, teachers reported that 35% of kindergarten children were not ready for school. Poor academic skills in the early years place children at risk, often leading to grade retention, school failure and dropout, delinquency and running away, as well as unemployment and underemployment in adulthood.

What has been done
During the 2015-2016 school year, the program was expanded to Yerington Elementary and Smith Valley Elementary in Lyon County. For the 2016-2017 school year, the program expanded to five more schools. The Little Books and Little Cooks program expanded to Washoe and Lincoln Counties, with help and leadership from faculty and staff in those counties. Overall changes in 2016 included the addition of six new books and six new recipes.

Results
For the Veggies for Kids 10-week series 250 students were reached through four-day summer institutes. No pre- or post-program was collected on the summer institute students. The Little Books and Little Cooks Program used paired t-tests were conducted to compare participants' responses and facilitators' observations to pre and post-test items. Participants showed significant improvements in school readiness skills, reading skills, cooking skills, eating and feeding styles and other life skills.

4. Associated Knowledge Areas

KA Code	Knowledge Area

703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #2

1. **Outcome Measures**

Number of individuals who implement behaviors to improve health and nutrition.

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Apply new knowledge to programs at the field level with a goal of significant long term weight loss and overall improvement of health in those who participate.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

To identify research activities such as new data sources, improved techniques for data analysis, and improved hypotheses for obesity research questions.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Grant availability)

Brief Explanation

The pace of Nevada's recovery remains slow, which in turn affects funding availability and support from county government, including school systems.

Initialization of epigenetic research was slowed by the simple fact that no one at UNR is conducting this line of work and optimizing plate readers, securing reagents and the tools necessary required considerable more time than expected.

In regards toward grape seed extracts, the climate in Reno Nevada may greatly influence the procyanidin profile of grape seeds resulting from the grapes grown on the UNR vineyard.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The effectiveness of the Little Cooks Little Books program was evaluated using three strategies: a pre- and post-parent self-report survey instrument (parent's feeding style, child's eating, family's eating style, etc.) based on published and validated tools; a pre- and post-observation checklist (child's cooking skills, parent-child interaction during cooking and mealtime observation) that was created for this program; and an overall post-program evaluation. Evaluations indicated improvements in key life skills, including parent's feeding style, child's eating, family's eating style, child's cooking skills, and parent-child interaction during cooking and mealtime observation.

The Experiment Station team synthesized a non-commercially available class I substrate for use in HDAC research on cardiac enlargement and hardening. From over 130 foods screened, the team identified 18 bioactive compounds that act as HDAC inhibitors.

The grape seed extract team has determined that GSPE effects on intestinal bile acid transporters functions as a new mechanism that leads to triglyceride-lowering effects in humans. The team has also discovered that GSPE acts as an HDAC inhibitor and in so doing increases the ability of the nuclear receptor to increase target gene expression. The Experiment Station team has fractionated GSPE into 25 components to determine what actually exerts the co-antagonistic effects with respect to bile acid bound FXR (which up- or down-regulates the expression of certain genes).

Experiment Station investigators studying Relapsing Fever have worked with effected homeowners and state and county public health personnel to help identify infected small mammal hosts around their property, search for the soft tick vectors in their cabins and detect areas in their homes/cabins that small mammals use to gain access inside and thereby expose the human inhabitants to the infected soft tick vectors.

Key Items of Evaluation

- 18 bioactive food compounds have been identified that inhibit HDAC, a protein know to enlarge and stiffen cardiac tissue
- A better understanding of how grape seed extract is molecularly affecting triglycerides in humans

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety

☑ 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
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		100%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.5	0.0	0.2	0.0
Actual Paid	0.0	0.0	0.2	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**
0	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	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

University of Nevada Cooperative Extension conducted the following programs to further the goals of

NIFA's Food Safety theme:

- Conduct a statewide assessment to identify specific food safety program topics and further identify target audiences.
- Provide educational and extension outreach support to market livestock and produce growers, to owners and operators of small and very small plants, and to food preparers and handlers, including minority populations such as Native Alaskans, Asian Pacific Islanders, and American Indians.
- Educate agricultural producers about methods to reduce food contamination and growth of foodborne organisms.
- Conduct In-depth cattle handling workshop to increased production and improved animal health through decreased stress.
- Support the development and transfer of practices and intervention strategies that manage, reduce, or eliminate food safety risk throughout the food chain.
- Educate agricultural producers about farm planning to ensure food safety, direct marketing, including legal, financial, and marketing risks.
- Educate agricultural producers about GAPs and GHPs.
- Provide producers educational and extension support for the implementation of HACCP.
- Partner with Nevada Department of Agriculture to build awareness of volunteer GAP and GHP certification processes.

The **Nevada Agricultural Experiment Station** conducted the following program to further the goals of NIFA's Food Safety theme:

Determine If Commercially Available Bacteriaophages Reduce Salmonella In Ground Meats
Experiment Station scientist inoculated refrigerated beef and poultry trim with four different strains of salmonella bacteria. Before grinding, samples were treated with one of three concentrations of SALMONELEX^{TM}, for either six hours or 30 minutes prior to grinding. Samples were then analyzed after being ground for levels of salmonella contamination.

2. Brief description of the target audience

University of Nevada Cooperative Extension and **Nevada Agricultural Experiment Station** target audience included:

- Agricultural producers, small acreage operators, and managers/operators of school/community gardens.
- Livestock producers who participate in Beef Quality Assurance (BQA)
- 4-H and FFA youth participating in statewide and local competitive events with market projects
- Food safety programs also target professionals in the retail food industry and custodial food providers in child and senior care facilities.
- Specific individuals or groups who have expressed a need for food safety research and extension information that is to be derived through new research, extracted from on-going research, or is derived from scientific literature.
- Other scientists, scientific groups and political entities.

3. How was eXtension used?

eXtension was not used.

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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	1	1

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Graduate Students or Post-Doctorates Trained

Year	Actual
2016	1

Output #2

Output Measure

- Number of Undergraduate Students Involved in Research

Year	Actual
2016	2

Output #3

Output Measure

- Workshops, Demonstrations, and Presentations

Year	Actual
2016	2

Output #4

Output Measure

- Abstracts, Books, Book Chapter(s), Proceedings, Research Reports, and Technical Publications

Year	Actual
2016	0

Output #5

Output Measure

- Brochures, Bulletins, Fact Sheets, Newsletter, and Surveys

Year	Actual
2016	0

Output #6

Output Measure

- Manuals and Other Printed Instructional Materials Produced

Year	Actual
2016	0

Output #7

Output Measure

- Digital Media and Web Sites Created or Updated

Year	Actual
2016	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of individuals who gain knowledge about foodborne illness, farm/ranch food safety, and quality assurance.
2	Number of individuals who implement practices to prevent foodborne illness, which include farm/ranch food safety plans and quality assurance practices.
3	Reduce food borne pathogens in the food supply chain.

Outcome #1

1. Outcome Measures

Number of individuals who gain knowledge about foodborne illness, farm/ranch food safety, and quality assurance.

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)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number of individuals who implement practices to prevent foodborne illness, which include farm/ranch food safety plans and quality assurance practices.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Reduce food borne pathogens in the food supply chain.

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)
Salmonella is one of the most common causes of food borne illnesses in the United States. The bacteria can cause diarrhea, fever, vomiting and abdominal cramps. It is estimated to cause one million foodborne illnesses in the United States every year, with 19,000 hospitalizations and 380 deaths, according to the Centers for Disease Control and Prevention.

Through the use of bacteriophages, specific to strains of salmonella, the meat scientists at the University wanted to determine the efficacy of commercially available products in improving food safety.

What has been done
Researchers treated meat products infected with four types of salmonella by applying Myoviridae bacteriophages during mixing. Bacteriophages are commonly found in our environment. They are viruses that can only harm specific bacterial cells and are harmless to humans, animals and plants.

In the experiments, the salmonella bacteria was inoculated on refrigerated meat and poultry trim, then the treatment was applied to the meat before grinding. The bacteriophages invaded the cells of the bacteria and destroyed them.

Results
Bacteriophages can be used as an additional impediment in robust food safety systems to improve the control of Salmonella in ground meat and poultry when applied on red meat and poultry prior to grinding. On the final ground meat products, there was a 10-fold decrease of salmonella. "The results are very encouraging and hopefully this approach will be adopted by the meat industry to increase food safety," states Dr Amilton de Mello, food safety professor at UNR.

Results from this study are now support documentation for HACCP plans that adopt bacteriophage application as part of their pathogen control pre-requisite programs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Grant funding available)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The fact that over 37 national publications picked up the "reduction in salmonella in ground meat" story posted to the Associated Press (http://www.unr.edu/nevada-today/news/2016/salmonella-reduction-research) is certainly an indication that people must be interested.

Key Items of Evaluation

- The use of SALMONELEX^{TM} in reducing salmonella in ground meat was over 90% effective.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Community and Economic Development

☑ 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	52%		0%	
605	Natural Resource and Environmental Economics	14%		0%	
608	Community Resource Planning and Development	34%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	0.7	0.0	0.5	0.0
Actual Paid	3.0	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
494549	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	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

University of Nevada Cooperative Extension conducted the following programs to further the goals of NIFA's Community and Economic Development theme:

These were: 1) Lincoln County Workforce Development, 2) Agriculture Innovation Forum Series, 3) Leadership Douglas County, 4) Moapa River Indian Reservation Strategic Housing Plan, 5) Nevada Volunteers: State Plan of Service, 6) Herds & Harvest, 7) Nevada Risk Management Education, 8) Stronger Economies Together (SET) and University Center for Economic Development Extension Programs, and 9) Native Waters on Arid Lands.

The Nevada Herds & Harvest Program combines a series of workshops on different topics and provides educational business management and mentoring programs to support Nevada beginning agricultural producers, with the goal of increasing their profitability and sustainability. The program completed its fifth year of existence in December 2016, and is in its second year of a three-year funding cycle. In 2016, 13 workshops were offered throughout the year, on topics such as business strategies, wine-making, goats, hops, and meat processing and safety. The Nevada Risk Management Education Program helps producers understand the risks they face in agricultural production and teaches strategies to mitigate those risks in order to increase the probability of economic survival and sustainability of Nevada's farms and ranches. This in turn, also helps to address the problem of Nevada's food deserts, and helps to provide healthy local produce and meat for Nevada citizens. The program teaches commercial, beginning, socially disadvantaged, and transitioning farmers and ranchers in Nevada about current federal crop/livestock and revenue insurance programs available to assist farmers and ranchers and minimize risks they face. In 2016, the project consisted of 11 different programs, including 39 workshops reaching 4,240 producers.

The Lincoln County Workforce Development program helps underemployed adults (ages 18+) and at-risk young adults (ages 17-24) in rural Nevada's Lincoln County to overcome barriers to obtaining education, training and sustainable employment. This includes identifying barriers; building confidence and hope; educating on how to match skills and interests with possible careers, how to plan a career path, how to apply for jobs; tutoring; working with local businesses to develop on-the-job training/employment experiences; and working with the community to develop the economy and jobs.

Stronger Economies Together (SET) and the University Center for Economic Development Program foster planned economic development throughout Nevada, in 2016 work was done to identify economic development opportunities for communities and the state, as well as to calculate economic impact or potential economic impact of certain policies, decision or actions. Major program work in 2016 includes:

1. Compared the clusters/industries that can link to advanced manufacturing initiatives in Nevada with a national analysis to identify potential areas of economic development for Nevada.
2. Did an analysis of the potential economic impact the endangered species listing for sage grouse might have, if passed, particularly on Nevada's agriculture and mining industries.
3. Updated the socioeconomic data in the Comprehensive Economic Development Strategy for the Western Nevada Development District, useful in applying for infrastructure and economic development grants from the federal government.
4. Did an analysis of the economic impact on Humboldt County of Humboldt General Hospital's operations and construction.

The Agriculture Innovation Forum Series provides practical information and know-how needed for agricultural producers and small-acreage owners to optimize their land use potential and maintain agricultural open space in Carson Valley. More specifically, the forum series offers options and solutions for surviving as a small agriculture entity. In 2016, a two-hour session covering a new topic was offered once a month for four months during the first part of the year.

Participants in Leadership Douglas County program met one day a month for 11 months for a class about leadership skill building, networking, focusing on critical community issues and learning about many important aspects of the county. In 2016, 18 participants completed the program.

The Nevada Volunteers: State Plan of Service program assisted the Nevada Volunteers group with strategic planning. Every three years, Nevada Volunteers revises and updates their State Service Plan. The plan is a strategic planning document developed to assess the level of voluntarism in Nevada, increase stronger partnerships for volunteerism, and identify strategies to strengthen volunteer and engagement efforts. As part of the planning process, Nevada Volunteers partnered with Nevada Extension to conduct six community forums throughout the state in the spring of 2016. The purpose of the forums was to gather information and share ideas about volunteerism, service and community engagement.

Native Waters on Arid Lands is a multi-state integrated research and outreach program that targets Native American tribes on reservation lands and comprise some of the nation's most water challenged and economically vulnerable populations. Since the five-year, grant-funded program began in 2015, research and Extension experts from 1862 and 1994 land-grant institutions have partnered with tribal communities to assess the impacts of climate change on future water supplies, identify barriers and solutions, and evaluate and prioritize actions to enhance the climate resiliency of tribal agricultural water resources and food systems. In 2016, the program held its second annual Native Waters on Arid Lands Tribal Summit, reaching 100 tribal members. The program was also featured in a panel presentation at the 2016 First Americans Land-grant Consortium meetings with approximately 200 tribal college faculty and staff members attending. Two presentations were also given in Washington D.C., to approximately 650 scientists.

The American Association for the Advancement of Science profiled the program in a video and media event reaching approximately 2,000 people. Research activities to date have focused on collecting socioeconomic and ecological data as well as developing climatic projections and an online information management portal.

2. Brief description of the target audience

University of Nevada Cooperative Extension target audience included:

1. Lincoln County Workforce Development: This program has two target audiences:
    1. 18+ Underemployed adults
    2. At-risk young adults ages 17-24 (at poverty level or below, and struggling in other ways, such as not progressing academically and failing to develop career paths). There were 31 participants in the 18+ underemployed adult program, and 53 participants in the at-risk young adult program.

2. Agriculture Innovation Forum Series: This program targets small-acreage agricultural owners.

3. Leadership Douglas County: This program targets adults in Douglas County, NV.

4. Moapa River Indian Reservation Strategic Housing Plan: This program targets the Moapa River Indian Reservation Tribal Council, Tribal Chairman, Tribal Members and Tribal Administrator.

5. Nevada Volunteers: State Plan of Service: This program targets businesses, individual volunteers, faith-based groups, nonprofits, civic organizations, and municipal and governmental agencies.

6. Herds & Harvest: The target audience for this project includes all Nevada beginning farmers and ranchers, who are identified and/or recruited through the department's agencies. The U.S. Department of Agriculture definition of farmer and rancher is used, which includes farmers and ranchers who sell $1,000 or more of an agricultural product. The majority of the targeted audience qualifies as socially disadvantaged and limited-resource beginning farmers and ranchers and comprises a significant portion of Nevada's agricultural operators. More than 6% of the total budget is allocated to serving American Indians living on the Walker River, Duck Valley, Pyramid Lake and Fallon reservations. In addition, the program organizers provide outreach activities to recruit military veterans, women, and Hispanic and limited-resource producers. Most of the producers are living and operating in U.S. Department of Agriculture-designated StrikeForce communities.

7. Nevada Risk Management Education: This program targets agricultural producers in Nevada.

8. Stronger Economies Together (SET) and University Center for Economic Development Extension Programs: This program targets economic development, government and business representatives, including Nevada Governor's Office and Office of Economic Development, Nevada Association of Counties, Western Nevada Development District, land managers, agricultural producers, mining industry professionals, hospital administrators, county commissioners, policymakers, the general public.

9. Native Waters on Arid Lands: This program targets American Indian tribal nations within the Great Basin and American Southwest region, in addition to 1994 institutions across the United States.

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	12567	0	930	46547

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	10	0	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Graduate Students or Post-Doctorates Trained
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Number of Undergraduate Students Involved in Research
  Not reporting on this Output for this Annual Report

Output #3

Output Measure

- Workshops, Demonstrations, and Presentations

Year	Actual
2016	80

Output #4

Output Measure

- Abstracts, Books, Book Chapter(s), Proceedings, Research Reports, and Technical Publications
  Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Brochures, Bulletins, Fact Sheets, Newsletter, and Surveys
  Not reporting on this Output for this Annual Report

Output #6

Output Measure

- Manuals and Other Printed Instructional Materials Produced
  Not reporting on this Output for this Annual Report

Output #7

Output Measure

- Digital Media and Web Sites Created or Updated
  Not reporting on this Output for this Annual Report

Output #8

Output Measure

- Databases and Models
  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 individuals who gain knowledge about community and economic development.
2	Number of individuals who implement knowledge about community and economic development.
3	Stakeholders will have the necessary models that will improve on the forecasting of risk, demand, and prices in various commodity sectors leading to enhanced decision making, increased profits, and reductions in uncertainty.
4	Research finding on valuing environmental resources, e.g. lakes, wetlands, river restoration, and how it applies to stakeholder needs for demonstrated gains in profits, resources sustained, and/or actions mitigated.
5	Biological complexity analyses to understand human-nature interactions at the landscape level that informs human enterprises, leading to demonstrated profitability, environmental protection, and/or improvements in quality of stakeholders' lives.
6	Market and non-market valuation of environmental resources that have often lacked economic justification that meets client needs, and informs individual, group, and government decision making.

Outcome #1

1. Outcome Measures

Number of individuals who gain knowledge about community and economic development.

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)

Historically, Nevada's economy has been dependent on the gaming and tourism industries. With the spread of gaming internationally, Nevada is diversifying its economy, and decision-makers are seeking expertise in gathering and analyzing data to identify areas for potential economic growth for specific counties and regions, as well as for the state as a whole. Education, outreach and mentorship programs that focus on improving the skills and abilities of Nevada beginning farmers and ranchers are imperative to building a sustainable, profitable agricultural economy in Nevada. Maintaining agriculture and open space is a priority in counties facing development pressures. Historically, Nevada has underused crop and livestock policies offered under the 2014 Farm Bill. Farmers and ranchers face five main areas of risk: legal, marketing, financial, human resources, and crop and livestock insurance.

Nevada Extension's programs serve Native Americans as well. Enhancing the climate resiliency of agricultural water resources on reservation lands of the Great Basin and southwestern United States is increasingly threatened by the risk of prolonged drought, flash floods and projected declines in surface and groundwater supplies. The Moapa Band of Paiutes are currently faced with overcrowding, with extended families and multiple families living under one roof.

Some counties continue to lag behind in economic recovery. As examples, Lincoln County has the lowest average weekly wage in Nevada. Douglas County, in 2009, identified five community priorities, including economic vitality; managed growth and development; preservation of natural environment, resources and cultural heritage; reliable, well-maintained infrastructure; community safety; and governance. Volunteers can be an important resource in this regard. Volunteerism and engagement are important for a healthy and resilient community. Higher rates of volunteerism and engagement in a community can improve government services, prevent crime, increase graduation rates, foster economic development and increase community responsibility for problem solving.

What has been done

In 2016, Nevada Extension provided educational activities for beginning farmers and ranchers, including forums focused on natural design in the landscape, natural weed management and control, and small-scale food production techniques. The Nevada Risk Management Education Program delivered information to farmers and rancher about risk management education, soil science, plant science, economics, livestock herd health and management, and Extension program development. The team worked with the U.S. Department of Agriculture?s Risk Management Agency and insurance agents to create scenarios, advertise, and provide outreach on closing dates and insurance products available in Nevada. Workforce development programs in Lincoln County provided participants with one-on-one consultation to assess their skills, interests, education levels and social barriers in regards to sustainable employment. The Stronger Economies Together (SET) and University Center for Economic Development Extension Programs completed analyses of: 1) clusters/industries that can link to advanced manufacturing in Nevada, 2) the potential economic impact the endangered species listing of the sage grouse would have on Nevada. 3) socioeconomic data in the Comprehensive Economic Development Strategy for the Western Nevada Development District and 4) the economic impact of Humboldt General Hospital. Nevada Extension helped Nevada Volunteers, a statewide organization, revise their State Plan of Service in 2016 by facilitating six forums across the state and creating reports with the discussion results. With regards to Native American communities, Nevada Extension conducted a modified SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis with the Moapa Paiute community to set a strategic goal for addressing community issues and identifying strategies and actions for each strategic goal. Nevada Extension offered its second annual Native Waters on Arid Lands Tribal Summit, attended by approximately 100 tribal members. Program faculty participated in a panel at the 2016 First Americans Land-grant Consortium meetings attended by approximately 200 tribal college faculty and staff.

Results

Participants in Nevada Extension's agricultural workshops reported significant levels of knowledge gain. Evaluation used a mixed methods approach to collect quantitative and qualitative impact data. Pre-tests and post-tests comparisons indicated that participants gained confidence and information in methods to: increase yields, improve product quality, increase income, add value to products, improve soil health and improve food safety. Statewide events focused on livestock, agricultural risk management, federal agricultural programs also used pre- and post-test evaluations, which found that participants found the information useful and felt better prepared to address these issues after being a part of these events. The results of economic analyses are: (1) being used by the Governor?s office and others to help guide efforts to identify and grow industries to contribute to Nevada's economy, (2) helping the Governor's office and the Nevada Association of Counties respond with research-based knowledge to the U.S. Bureau of Land Management and other agencies regarding the potential impacts to the state of listing the greater sage grouse as a threatened species, (3) being used by the Western Nevada Development District and the regional office of the U.S. Economic Development Administration, and will help the Western Nevada Development District to more successfully compete for infrastructure and economic development grants from the federal government and (4) being used by Humboldt General Hospital to show the hospital's contributions to the local and state economy. Nevada Extension's work with the Nevada Volunteer network increased partnerships across the state, led to recognition of the need for stronger networking within and outside various sectors, developed tangible strategies for strengthening volunteerism and engagement within each community, and articulated the need for Nevada to have a volunteer connector or hub system in local communities (virtual or physical) to serve as a place for all things volunteer-related. Nevada Extension's programs with Native Americans produced a strategic plan for the Moapa Paiute tribe that encompassed five critical categories. The Tribal Summit attendees completed post

conference evaluations and indicated knowledge gains in water resources, innovative range management strategies, the implications of future climate projections, and the value of traditional ecological knowledge in climate planning.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development

Outcome #2

1. Outcome Measures

Number of individuals who implement knowledge about community and economic development.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Stakeholders will have the necessary models that will improve on the forecasting of risk, demand, and prices in various commodity sectors leading to enhanced decision making, increased profits, and reductions in uncertainty.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action 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
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
608	Community Resource Planning and Development

Outcome #4

1. Outcome Measures

Research finding on valuing environmental resources, e.g. lakes, wetlands, river restoration, and how it applies to stakeholder needs for demonstrated gains in profits, resources sustained, and/or actions mitigated.

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Biological complexity analyses to understand human-nature interactions at the landscape level that informs human enterprises, leading to demonstrated profitability, environmental protection, and/or improvements in quality of stakeholders' lives.

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Market and non-market valuation of environmental resources that have often lacked economic justification that meets client needs, and informs individual, group, and government decision making.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Nevada's economic recovery remains slow, especially in rural areas. The four year drought ended with record precipitation amounts, especially in western Nevada and the Sierra Mountains. However, many unusually large storms created flood hazards, which led to lasting inundation and a 2017 federal disaster declaration in many counties. Nevada Extension's allocation of Smith Lever funds decreased slightly, as did allocations from the Nevada's general fund. This substantially increased the level of involvement of counties in matters related to Extension governance, which led to often contentious discussions with county commissions.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Nevada Extension evaluates all community and economic development programs, including statewide workshops and presentations and longer term direct consultations with communities (see references to the Moapa Paiute tribe). Nevada Extension's evaluations from 2016 events indicate that programs addressed a wide range of issues very effectively, as demonstrated by pre- and post-event surveys. Nevada Extension's 2016 efforts reached many thousands of people throughout the state. Follow-up surveys in 2017 should demonstrate significant changes in agricultural, community and tribal economic growth, strategic planning and community management.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Human and Family Development

☑ 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
801	Individual and Family Resource Management	15%		0%	
802	Human Development and Family Well-Being	35%		0%	
805	Community Institutions and Social Services	25%		0%	
806	Youth Development	25%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	2.5	0.0	0.0	0.0
Actual Paid	2.9	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
277280	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	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

University of Nevada Cooperative Extension conducted the following programs to further the goals of NIFA's Families, Youth, and Communities theme:
A significant portion of this work falls under the 4-H programming area, with traditional 4-H clubs, afterschool programs, summer camps, science camps, military family programs, etc. This work will be reported by the state's 4-H Director in her report on 4-H programming for the year.

However, University of Nevada Cooperative Extension also does a significant body of work in the program area of "Families, Youth, and Communities" that is not connected to conventional 4-H programs, including programs promoting early childhood literacy, addressing child maltreatment and domestic violence, mentoring at-risk youth or those involved in the juvenile justice system, and addressing other important needs.

Nevada Extension delivered the following eight (8) programs:

1. Keeping Kids Safe: Recognizing, Reporting and Responding to Child Maltreatment Training in Elko County,
2. Heart and Shield: Rural Domestic Violence Prevention Program,
3. Yerington Paiute Tribe Maternal, Infant, and Early Childhood Home Visiting Program,
4. 4-H Youth and Families with Promise Mentoring Program - Churchill County,
5. Project MAGIC,
6. GEAR-UP (Gaining Early Awareness and Readiness for Undergraduate Programs) Extension Components: a) Research and Evaluation, and b) STEM Education for Rural Nevada Adolescents,
7. Striving Readers, and
8. Family Storyteller.

The 4-H Youth and Families with Promise Mentoring Program in Churchill County mentors at-risk youth ages 10-14 affiliated with the Fallon Paiute Shoshone Tribe to help them avoid involvement in the juvenile justice system by helping them to build and enhance academic and social skills; and to improve their leadership, citizenship and life skills. Elements of the program include a weekly 4-H club activity; a trained adult mentor who meets with assigned youth; and a Family Night Out event at which youth, family members and mentors interacted once a month.

Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR-UP) is a federal program designed to increase the number of low-income students who are prepared to enter and succeed in postsecondary education. Students are identified during seventh grade and exposed to GEAR-UP activities that continue through high school. Activities are designed to create student interest in STEM and future careers that include college education. The project is in its fifth year of implementation. The University of Nevada Cooperative Extension component of the grant has had two components: program research/evaluation including nine Nevada counties and providing STEM education in three rural Nevada counties.

The Striving Readers program focused on building a strategy to strengthen engagement with families, working with them to improve literacy for all children birth through 12th grade. It was a principally grant-funded five-year program ending in September 2016. Thus, many of the direct-contact activities had ended or were winding up in 2016. Through the course of the grant, four school districts were served. The activities over the past five years have included six major components:

1. literacy training and coaching at community child care sites;
2. completing pre- and post-Early Language and Literacy Classroom Observation (ELLCO) assessments in preschool classrooms and Infant Toddler Assessment of Language and Literacy in infant/toddler classrooms, and assessing preschool children's language skills;
3. providing coursework for the Child Development Associate (CDA) credential or professional development hours for teachers;
4. offering the Family Storyteller Program for parents and young children at elementary schools and child care centers that guides parents on how to read with their young children;
5. conducting home visits to engage high-risk families with newborns to 5-year-olds with parenting information and resources; and
6. developing 40 Striving Reader's Tip Sheets and Videos, literacy enhancement materials for students in grades K-12. This report will focus on efforts completed in 2016, as the program was wrapping up its last year of grant funding. In addition, information on the Family Storyteller portion of this program is provided in a separate Impact Statement, as that program has been a stand-alone program for many years, before being partially incorporated into the Striving Readers Program.

Family Storyteller is a nationally recognized suite of family literacy programs for parents and their young children and beginning readers. The primary purpose of the program is to increase the amount and quality of time parents and young children spend together in literacy-enriching activities and to enhance school readiness and parent engagement. The overall program includes English, Spanish, English Language Learner, Infant/Toddler (English and Spanish) and Native American versions. It includes six weekly sessions during which families: learn about the importance of literacy for their children; discuss key parent/child reading techniques; watch a video that models the techniques; practice reading; learn about extender activities that enhance the value of the reading; and receive a free book and materials to complete the extender activities at home. Carefully selected books are featured in the project and provide the cornerstone for children's emerging literacy and academic skills.

In the Yerington Paiute Tribe Maternal, Infant, and Early Childhood Home Visiting Program weekly home visitations using the Parents as Teachers Home Visitation Model, the program seeks to develop the infrastructure within the Yerington Paiute Tribe Healthcare System to foster healthy, safe and self-sufficient families. The visitation model, which was adapted to the community's needs, supports voluntary, evidence-based home visiting services during pregnancy and to parents with young children up to kindergarten entry. In 2016, two children entered kindergarten with higher test results than peers who did not go through the program, and many parents were better prepared to reenter the workforce because of the resume drafting and career development referrals provided through the program. In addition, the program helped families engage their children in meaningful play and activities that impacted the children's gross motor skills, fine motor skills, intellectual/cognitive development, social and emotional development, and language development.

The Keeping Kids Safe program educates those working with youth or providing child care about how to recognize, respond to and report possible child maltreatment, including abuse and neglect. This not only helps to protect Elko's children and youth, but also helps Elko's child care providers and those working with youth to comply with state regulations that require these workers to have training on this subject within three months of beginning employment. A training based on a curriculum developed by University of Nevada Cooperative Extension faculty was delivered to child care providers and those working with youth in Elko by the Elko County Extension Educator five times in 2016. Program goals are that participants will increase their awareness/knowledge of the four types of child maltreatment; how to recognize child maltreatment; how, when, where and what to report when one suspects child maltreatment; how to respond when a child discloses abuse; program policies to protect children and staff; and caregivers' responsibilities and rights related to child maltreatment.

The Heart and Shield program began in 2009, and then received a five-year CYFAR/NIFA grant in 2013. It

has three major components:

1. development of an online law enforcement domestic violence training that addresses the dynamics of domestic violence from the 911 call to successful prosecution;
2. direct education and non-crisis intervention for children and families experiencing family violence to promote resiliency, strengthen positive future relationships, and stop the cycle of domestic violence; and
3. education of community members and leaders about the impact of domestic violence and creation of a supportive community. In 2016, most efforts were focused on the second and third components. The second component consisted of a nine-week education program for children, youth and parents; and a monthly family activity to foster attachment and bonding among family members. The third component consisted of discussions, presentations and work with local agencies and human services providers to teach about domestic violence, its prevalence, how to help victims, and how to refer families to the Heart and Shield Program.

2. Brief description of the target audience

University of Nevada Cooperative Extension target audience included:

1) Keeping Kids Safe: Recognizing, Reporting and Responding to Child Maltreatment Training in Elko County: Child care providers and youth workers in Elko County. There were 75 workers trained at the five trainings in 2016.

2) Heart and Shield: Rural Domestic Violence Prevention Program: For the education/non-crisis intervention component: Survivors of domestic violence and their children living in Elko and Churchill Counties, consisting of four age categories: 1) adults/parents, 2) teens ages 14-18, 3) youth ages 9-13, and 4) early childhood birth to 8 years old. For the community education component: community leaders, human services providers, nonprofit agencies and the community at large.

3) Yerington Paiute Tribe Maternal, Infant, and Early Childhood Home Visiting Program: Tribal families, tribal community, tribal leadership, tribal agencies, state and local agencies, stakeholders.

4) 4-H Youth and Families with Promise Mentoring Program - Churchill County: At-risk youth, ages 10-14, affiliated with the Fallon Paiute Shoshone Tribe, referred to the program due to having below-average school performance, poor social skills and/or weak family bonds.

5) Project MAGIC: Entry-level juvenile offenders, ages 12-18, referred from rural Nevada county probation departments and their parents.

6) GEAR-UP (Gaining Early Awareness and Readiness for Undergraduate Programs) Extension Components: a) Research and Evaluation, and b) STEM Education for Rural Nevada Adolescents: For research/evaluation component: Staff and leadership in 18 low-income (50% receiving free or reduced-price lunch) and "in needs of improvements" middle schools in nine Nevada counties. For STEM education component: Adolescents in seven of these schools in three rural Nevada counties. Also, GEAR-UP staff and leadership teams from these schools were a secondary target audience, receiving training in STEM education program delivery.

7) Striving Readers: Families with children newborn to age 5, early childhood teachers, families who have children in targeted at-risk schools or live in neighborhoods surrounding those schools.

8) Family Storyteller: Families with infants, preschoolers or beginning readers at risk for developing literacy and language deficits, academic problems, and social difficulties.

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	5206	720	9002	720

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	5	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of youth, families, and professionals who gain knowledge about positive human and family development.
2	Number of youth, families, and professionals who implement positive human and family development behaviors.

Outcome #1

1. Outcome Measures

Number of youth, families, and professionals who gain knowledge about positive human and family development.

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)
The Yerington Paiute Tribe has struggled with a wide range of social issues and families live well below the federal poverty level. Literacy is the fundamental skill and only one-quarter of Nevada's school-age children read at or above proficiency. Preventing child abuse and neglect was ranked as the second-highest priority in a Mailed Survey: Priorities for Elko County needs assessment published in 2012. Nevada has one of the highest per capita juvenile incarceration rates in the nation. Nevada's domestic violence rates continue to be some of the highest in the nation.

What has been done
For the Yerington Paiute Tribe Maternal, Infant and Early Childhood Home Visiting Program, In 2016, the program finished collecting data for an overall assistance portion, which provided services to and collected national benchmark data for 15 enrolled families, and a case-study portion, which collected more in-depth data on the program?s impact on nine of the 15 families. In 2016 in Clark County, 180 Family Storyteller classes were taught. In Washoe County, 239 families were reached during the six-week sessions at 19 at-risk elementary schools, including 254 adults (229 Spanish-speaking and 25 English-speaking) and 352 children (332 Spanish-speaking and 20 English-speaking). The Clark County Striving Readers team completed pre- and post-early language and literacy classroom observation assessments in preschool classrooms and infant classrooms and assessed children?s language skills. The Washoe County Striving Readers team conducted 166 family home visits targeting high-risk families with newborns to 5-year-olds to engage them with parenting information and resources. The Elko County Extension Educator provided the trainings quarterly based on the curriculum, Kids Deserve a Safe Place to Grow. In 2016, 23 adults and 51 youth participated in the direct education and non-crisis intervention part of the Heart and Shield Program.

Results

The Yerington Paiute Home Visiting Program involved a community of leaders and tribal members in the shared responsibility to its tribal families. Significant gains were reported in knowledge, skills and confidence after completing the Family Storyteller workshops. In the Striving Readers Program children's emergent language and literacy skills were assessed using children?s writing skills and Preschool Early Literacy Indicators (PELI: alphabet knowledge, comprehension, vocabulary, phonological awareness). Significant improvement was found in most of the parameters. For the Keeping Kids Safe Program all participants showed a significant increase in awareness of how to recognize, respond to and report child maltreatment, and having the confidence to do so, as measured by a 15-question pre- and post-test. For Project MAGIC evaluation results showed that youth participants showed significant improvement in more than 15 academic, social, civic and life skills needed to prevent recidivism.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
805	Community Institutions and Social Services
806	Youth Development

Outcome #2

1. Outcome Measures

Number of youth, families, and professionals who implement positive human and family development behaviors.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The community and nonprofit partner, The Children's Cabinet, continue to see this as a necessary and valued program in Elko County. For 2016 evaluation and results, see Quantitative Outcome/Impact above.

What has been done

Since 2013 in Elko County, the Extension Educator has provided this training at least quarterly, with 155 adults, and 19 youth completing the training in Elko County since 2013 and showing a significant increase in awareness of how to recognize, respond to and report child maltreatment, and having the confidence to do so.

Results
No results to report at this time.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
805	Community Institutions and Social Services
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Grant funding availability)

Brief Explanation

Changing appropriations at the county and state level adversely affected the funding stream to support this program.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The Yerington Paiute Home Visiting Program involved a community of leaders and tribal members in the shared responsibility to its tribal families. The program showed measurable success in developmental benchmarks in children. It helped families engage their children in meaningful play and activities that have impacted the children's gross motor skills, fine motor skills, intellectual/cognitive development, social and emotional development, and language development. 254 parent participants reported significant gains in knowledge from the Family Storyteller program, according to a pre- and post-assessment. On a scale from 1 (low) to 5 (high), the parents were asked to rate their knowledge, skills and confidence in regards to enhancing their children's literacy development before and after the workshops. The parents reported significant gains in knowledge, with the mean score being 3.39 before taking the workshops, and the mean score being 4.82 after taking the workshops. The Striving Readers Program Children's assessed emergent language and literacy skills using children's writing skills and Preschool

Early Literacy Indicators (PELI: alphabet knowledge, comprehension, vocabulary, phonological awareness). Significant improvement was found in most of the parameters. In the Keeping Kids Safe program organizers used a survey to assess knowledge gains. This included a Likert-type scale with 1 = No Confidence and 5 = Complete Confidence, or with 1 = Not At All Aware and 5 = Very Aware. Post-test scores ranged from 4.56 to 4.94, and gains over the pre-test ranged from .13 to 1.19. Two of the questions reflecting the most significant gains in knowledge and impact of the program are:
- "How confident are you in recognizing indicators of child abuse and/or neglect of a child?" Post-test score was 4.59, up from the pre-test score of 3.56.
- "How confident are you in being able to make a report of suspected child abuse and/or neglect of a child?" Post-test score was 4.56, up from the pre-test score of 3.37.
In the Heart and Shield Program, staff observed changes in knowledge and behavior in all participants.

Key Items of Evaluation

None at this time.

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.