

# 2017 New Mexico State University Combined Research and Extension Annual Report of Accomplishments and Results

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## I. Report Overview

### 1. Executive Summary

New Mexico State University College of Agricultural, Consumer and Environmental Sciences (ACES) research, academic, and Extension activities fall into three broad strategic themes, which consist of our planned programs for this Plan of Work. Each planned program is comparable to a NIFA portfolio, with associated Knowledge Areas (KAs). The three college strategic themes are: Agriculture and Natural Resources; Community and Economic Development; and Human Capital. Each strategic theme has administrative support and civil rights functions associated with it. NIFA has developed five mandatory priority areas. We have explicitly addressed two areas (Global Food Security and Hunger; Food Safety) by renaming and reorganizing existing planned programs. The remaining priority areas are reported in our existing research and Extension programs. We have listed those priority areas separately, although we will not report anything in those areas per se.

ACES uses the Academy of Sciences definition of agriculture: the service of producing, distributing, marketing, and consuming food and fiber. This incorporates use, conservation, development, and management of air, land, and water resources. The Agriculture and Natural Resources strategic theme, then, includes the following planned programs: Sustainable Management of Natural Resources; Global Food Security and Hunger; and Food Safety.

The Sustainable Management of Natural Resources planned program contains the KAs covering Soil, Plant, Water, Nutrient Relationships; Management of Saline and Sodic Soils and Salinity; Management of Range Resources; Management and Sustainability of Forest Resources; Urban Forestry; Aquatic and Terrestrial Wildlife; Conservation of Biological Diversity; Waste Disposal, Recycling, and Reuse; Drainage and Irrigation Systems and Facilities; and Natural Resource and Environmental Economics.

The Global Food Security and Hunger planned program contains the KAs dealing with animal genetics and genomics, nutrition, reproduction, physiology, stresses, and management systems; genetics, genomics, stresses, efficiencies, and management systems of plants; and pests and pathogens of plants and animals, weeds, biological control and integrated pest management systems, and animal welfare/protection. The Food Safety planned program incorporates the KAs dealing with new and improved food products and processing techniques, quality maintenance, and protection from pathogens.

The Community and Economic Development strategic theme contains the Agricultural Markets, Trade, and Economic/Business Development planned program. This covers marketing, community development, and economic policy.

ACES' Human Capital strategic theme contains two planned programs: Health and Wellbeing; and 4-H and Youth Development. The Health and Wellbeing planned program covers nutrition and nutrition education, healthy lifestyles, family resource management, family development, and how social changes affect individuals. The 4-H and Youth Development planned program incorporates all remaining programs involved with youth development.

This year ACES has modified its procedures to include at the top level those professional and scientist FTEs from all CES/AES funding sources, resulting in a noticeable increase of reported FTEs from previous years. In each POW planned program, though, ACES has counted only those professional and scientist FTEs funded by Hatch or Smith-Lever 3b&c capacity funds. Capacity funds not attached to FTE salaries were expended in program operations.

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

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	30.9	0.0	56.1	0.0
Actual	70.1	0.0	141.8	0.0

**II. Merit Review Process**

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

- Internal University Panel
- External University Panel
- External Non-University Panel

**2. Brief Explanation**

We use internal faculty review and external advisory group review of our planned programs. As appropriate, departments are reviewed by a panel of NIFA and land-grant university peers.

**III. Stakeholder Input**

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

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

**Brief explanation.**

New Mexico State University uses a variety of methods to inform and collect feedback from our stakeholders. We continually evaluate their effectiveness and consider new ways to communicate with our stakeholders.

**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

**Brief explanation.**

NMSU uses advisory committees, focus groups, and knowledge by specialists and agents to identify stakeholders.

**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
- 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
- Meeting with invited selected individuals from the general public

**Brief explanation.**

The College of ACES meets with individuals and groups throughout the year to garner input directly.

**3. A statement of how the input will be considered**

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

**Brief explanation.**

Feedback from our stakeholders is used to plan the College's priorities in research and extension. This includes deciding budgets and hiring decisions.

**Brief Explanation of what you learned from your Stakeholders**

Federal priorities often do not align with state/local priorities.

**IV. Expenditure Summary**

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totalled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1443277	0	1264288	0
Actual Matching	1443277	0	1264288	0
Actual All Other	0	0	0	0
Total Actual Expended	2886554	0	2528576	0

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

## V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Global Food Security and Hunger
2	Agricultural Markets, Trade, and Economic/Business Development
3	Sustainable Management of Natural Resources
4	Food Safety
5	Health and Wellbeing
6	4-H and Youth Development
7	Climate Change
8	Sustainable Energy
9	Childhood Obesity

**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
201	Plant Genome, Genetics, and Genetic Mechanisms	6%		6%	
202	Plant Genetic Resources	6%		6%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	14%		14%	
204	Plant Product Quality and Utility (Preharvest)	6%		6%	
205	Plant Management Systems	5%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	4%		4%	
212	Pathogens and Nematodes Affecting Plants	6%		6%	
213	Weeds Affecting Plants	10%		10%	
215	Biological Control of Pests Affecting Plants	3%		3%	
216	Integrated Pest Management Systems	2%		2%	
301	Reproductive Performance of Animals	10%		10%	
302	Nutrient Utilization in Animals	10%		10%	
305	Animal Physiological Processes	10%		10%	
306	Environmental Stress in Animals	5%		5%	
307	Animal Management Systems	3%		3%	
<b>Total</b>		100%		100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	11.7	0.0	30.7	0.0
<b>Actual Paid</b>	7.6	0.0	6.8	0.0
<b>Actual Volunteer</b>	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
578503	0	774900	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
578503	0	774900	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**

- Guar research at NMSU has shown that guar can be successfully grown in New Mexico conditions and can help reduce reliance on imports (estimated US guar imports in 2012 \$1 billion) to meet needs of the US gas and oil industry. Guar work at NMSU is helping growers with an alternative option, leading to an increased awareness and interest in domestic guar production with a potential to reduce reliance of US oil industry on billion dollars' worth of international guar imports.

- Cover crop research efforts have provided information on cover crop options that can be integrated in organic or conventional cropping systems by local growers to meet their sustainability goals. Growers in NM face several challenges including adoption of cover crops, crop rotations and alternative crops for limited water agriculture. The NMSU Sustainable Crop Production program participants indicated an improved knowledge that is helping them to make informed decisions about cover crops/crop rotations to meet their sustainability goals in conventional and organic systems.

- NMSU researchers have completed work on egg extraction techniques invasive stink bug *Bagrada hilaris* in New Mexico. This provides valuable information on the best way to sample for this life stage of this important pest. This complements previous work on the odd egg laying behavior of *B. hilaris*. The research documents that this is the first known species of the 5000 worldwide that lays its egg singly in the soil and then buries it. This has major implications for the management of this pest species, particularly in regard to biological control, sampling, and overall management.

- In alfalfa, several projects are various stages of completion. We continue work on the seasonal phenology of the alfalfa weevil. We have completed a project on the comparative development of the alfalfa weevil strains in the laboratory. This work is the first to compare the development of all three U.S. strains under identical environmental conditions. It also compares individual feeding potential among late-instar larvae. We have created a preliminary list of the blister beetles of New Mexico. Currently, we have found ~70 species of blister beetles in the state, only 7 found in alfalfa.

- The nematode *Ditylenchus dipsaci* was initially confirmed in New Mexico in 2015 from infected garlic plants received from a home gardener in Doña Ana County. The confirmation triggered a systematic survey of 54 commercial onion fields in this and the two adjacent counties in an attempt to detect additional infested sites. Fresh market onions are the leading annual crop in NM, and nearly all production occurs in the counties surveyed. Survey fields were allocated equally between those containing fall-planted (short day length) and spring-planted (long day-length) varieties. Putative *Ditylenchus* spp. were recovered at low numbers (< 60/100 cm<sup>3</sup> soil) from 21 fields (10 fall- and 11 spring-planted cultivars; 39% of fields surveyed). Multiple single-nematode specimens were collected from each infested field and identified using direct sequencing of 18S and ITS regions of the rRNA genes. When identified using only

18S sequence data, 60% of individuals were identified as *D. dipsaci* (99% similarity), 27% as *D. destructor* (98% similarity), with the remainder somewhat resembling *D. destructor* (92-94% similarity) - both of which are species of international regulatory concern that would prevent export to Canada (primary foreign market for NM onions). When direct sequencing data was expanded to include the ITS-1 region, none of the individuals were identified as *D. dipsaci* or *D. destructor*. Species with the greatest similarity to those recovered included *D. arachis* (92% similarity) and *D. persicus* (90% similarity).

- A microplot study initiated in 2016 to determine the response of pinto bean and *M. incognita* populations to different rates of fluensulfone (Nimitz®) and fluopyram (Velum® One) was repeated in 2017. Mean J2 populations at the end of the season were 39% and 20% lower in plots that received 5.0 and 7.0 pt/acre fluensulfone respectively compared to untreated control plots or those treated with 3.5 pt/acre fluensulfone. Yield data is still being analyzed. A separate field study was established to compare efficacy for management of *M. incognita* and plant response of direct-seeded chile pepper (*Capsicum annuum* cv Sandia) to three rates of fluensulfone broadcast, three rates banded, and 1,3-dichloropropene under furrow irrigation. Yield data and final nematode counts are still being collected. A third study was conducted under crop-destruct restrictions to measure *M. incognita* management and plant response of two year old grape (pinot grigio scion on 'Freedom' rootstock) to two rates of fluensulfone and spirotetramat. J2 numbers were 84%, 74%, and 53% less than untreated plots in response to treatment with 8 oz/acre spirotetramat, 3.5 pt/ acre and 5.0 pt/acre fluensulfone, respectively. Average berry yields were 30% greater in all treated plots compared to the untreated controls.

- Tracking collars are used to monitor cattle movements and develop grazing distribution phenotypes. However, few studies have evaluated the consistency of cattle movements over time in rugged rangeland pastures. We examined the repeatability of cattle movement patterns at five locations in New Mexico and Arizona: the Chihuahuan Desert Rangeland Research Center (CDRRC), Evans Ranch, Wilbanks Ranch, Hartley Ranch and Todd Ranch.. Eight to 19 randomly-selected cows from herds of 40 to 200 cows were tracked with GPS collars at each ranch. Cows were tracked at either 10- or 15-minute intervals. Terrain use was summarized by week. A repeated measures analysis was conducted on each ranch using the weekly average of slope use, elevation use, and distance from water as the dependent variables. Intraclass correlations of weekly averages of the three terrain use metrics were used to assess temporal consistency of grazing distribution traits. Week was a fixed effect and cow was a random effect. Intraclass correlations of terrain use by individual cows varied among ranches. The Wilbanks Ranch had the strongest intraclass correlations for slope, elevation, and distance to water of 0.60, 0.50, and 0.77, respectively. Intraclass correlations for elevation at the Hartley and Todd Ranches were strong, 0.61 and 0.71, respectively, but correlations for slope and distance to water were weak to moderate (0.18 to 0.30). In contrast, intraclass correlation at the CDRRC and Evans Ranch were weak (0.00 to 0.08). Our results suggest that consistency of terrain use by cattle can vary by location; however, these relationships are positive and moderate to strong at most ranches. Factors such as cattle familiarity with pastures and the nature of the terrain features may explain part of this variability, however additional analyses examining how temporal changes in terrain use affect this phenotype are planned.

- Terrain use and grazing distribution traits in cattle are difficult to evaluate because movement patterns are temporally variable due to ever changing climatic and forage conditions. Terrain-use can be monitored with GPS collars, but the length of tracking is constrained by battery life and on-site grazing and management plans. Cattle tracking studies have varied from days to months. We evaluated data from our studies to determine if shorter, 30 to 60 day, sampling durations were as effective as a 3 month tracking periods for characterizing slope and elevation use, and vertical and horizontal distance traveled from water of individual cows. A total of 39 cattle from 3 ranches in New Mexico and Arizona were tracked at 10- to 15-minute intervals for 89 to 92 days in pastures that included both gentle and rugged terrain. Terrain-use during 30- and 60-day periods at the beginning and end of the tracking were compared to the full 92-day period. Slope, elevation, and vertical and horizontal distance from water from the full sample period were regressed on values from the shorter data subsets and correlations were calculated between sampling periods for each pair of terrain use metrics. The 60-day periods showed strong agreement with the full 92-day period with correlation coefficients varying from 0.90 to 0.97. Correlations between 30-day periods and the 92-day period varied from 0.30 for distance to water during the early period to 0.90 to 0.93 for all

traits during the late 30-day period. These preliminary analyses suggest that 2-month tracking periods are equivalent to 3-month tracking periods for identifying differences in terrain-use among beef cows. These findings help facilitate collection of grazing distribution phenotypes from larger number of cattle for genetic improvement.

- Only a few studies have examined the impact of cow size on grazing distribution. Tracking data collected in this project at the CDRRC (Las Cruces, NM) was used to determine if there are relationships between cow body size and terrain use. Fifteen Brangus cows (2 to 13 years of age) were tracked at 10-minute intervals in a 2635-ha pasture with rugged terrain for 12 weeks during the winter prior to calving. After fitting the statistical model for age, residual correlations were used to examine the relationship between cow weight, body condition score, linear measures of cow size, and terrain use metrics. Larger cows with bigger heart girths and heavier weights used areas farther horizontally from water than smaller cows and the associated residual correlations were 0.52 and 0.64, respectively. Cows with greater hip heights and heavier weights used areas farther vertically from water (residual correlations of 0.85 and 0.53, respectively). Although the number of cows are limited, these preliminary results suggest that larger cows may be more willing to travel farther from water than smaller cows in extensive, rugged desert pastures during cool winter conditions.

- We have demonstrated that alfalfa plants overexpressing the gene encoding for an enzyme sucrose phosphate synthase (SPS) and cytosolic glutamine synthetase (GS1) in alfalfa, results in increased biomass and improved nodule function. SPS catalyzes the synthesis of sucrose, which is the major form of photosynthate used as a source of energy and C required for N assimilation while GS<sub>1</sub> catalyzes the first step in N assimilation in vasculature and the root nodules. The goal of the project is to subject these transformants into extensive analysis at the physiological, biochemical and molecular levels and to check the transformants for some of the important traits like forage quality, tolerance to drought stress along with increase in biomass. An extension of this objective is co-express the two transgenes in organ-specific manner. An additional is to move the transgene into elite lines produced by the alfalfa breeding group at NMSU. Molecular analysis of these two classes of transformants (SPS and GS1), show that while the SPS overexpressing plants show an induction of endogenous cytosolic GS genes, in the nodules and the GS overexpressing transformants show an induction in the endogenous SPS genes both in the leaves and the nodules. Furthermore, both sets of transformants show an increase in sucrose levels (sucrose being a product of SPS activity) compared to control plants, suggesting that sucrose may be the signal involved in the induction of both the endogenous GS1 gene and the SPS genes. The genes involved in the C and N metabolizing enzymes that eventually lead to the synthesis of glutamine and asparagine, are also induced in the nodules of both classes of transformants. The increase in the levels of the two transport amino acids, Gln and Asn, probably attributing to increased nitrogen content in the leaves and increased growth. Analysis of the SPS transformants showed superior forage quality.

- The broad host range resistance gene from wild potato (RB) has been tested for effectivity against *P. capsici* by agroinfiltration of chile plants. Initial results show that the RB gene from potato does confer resistance to *P. capsici* in chile plants. We have also produced stable chile transformants with the RB gene. These putative transformants have been tested positive for the presence of transgene in the genome. These plants have been selfed and the progeny tested for the presence or absence of the transgene. The F1 progeny showed 3:1 ration with regards to the presence of the transgene. The F1 plants with the gene have shown partial resistance to *P. capsici* both by leaf and root inoculation.

- Capsidiol is the major phytoalexin in *Capsicum annuum* and *Nicotiana tabacum*. Capsidiol is a bicyclic dihydroxylated sesquiterpene derived from the isoprenoid pathway in the cytoplasm, its synthesis is initiated by the cyclization of farnesyl diphosphate into 5-epi-aristolochene (EA), a reaction catalyzed by a **sesquiterpene cyclase known as 5-epi-aristolochene synthase (EAS)**, then capsidiol is synthesized by the hydroxylation of EA catalyzed by the **5-epi-aristolochene hydroxylase (EAH)**. In solanaceous plants, the EAS and EAH genes, and homologous genes associated with the biosynthesis of terpenoid phytoalexins, are encoded by multigene families. It has been found that some of the EAS and EAH genes identified in *Capsicum* and *Nicotiana* species are inducible by pathogen infection. Two genes encoding for the two enzymes in the biosynthesis of capsidiol (phytoalexin in *Capsicum*) has been isolated from a wild *Nicotiana* species and has been introduced into chile. The transformants will be tested for resistance to

different pathogens like *Phytophthora* and *Verticillium*. We have cloned several EAS genes from the tobacco species *Nicotiana rustica*, and identified a promoter region for one of the EAS gene members. Initial bioinformatics analysis has shown that this EAS gene promoter has the regulatory elements involved in the pathogen defense signaling pathways. What is very unique about this promoter is that it is flanked on either side by the genes encoding for the two key enzymes in the synthesis of capsidiol, EAS and EAH. Having a dual pathogen inducible promoter driving EAS and EAH, would ensure the quick and coordinate synthesis of the two enzymes needed for capsidiol synthesis at the site of infection.

- We hypothesized that a microbial pathogen load in the soil of feedlot pens is a predisposing factor to liver abscesses in cattle, as reflected by similar bacteria isolated from the soil, rumen wall and liver abscesses. Samples were collected from 14 commercial feedlots (larger than 40,000 animals each) and 3 commercial slaughter facilities in the following 3 different geographical regions: Arizona, Colorado and the Texas Panhandle. The selected packing plants harvested both beef and Holstein cattle and approximately 6,000 liver and rumen epithelial samples were collected across breed. Results obtained from this study indicated that breed and days on feed were correlated to liver abscesses, and there was no association between liver abscess incidence and the level of rumen damage occurring as a result of acidosis. There was also no correlation between liver abscess percentage and the use of tylosin phosphate.

- Data from the analysis of samples (soil, manure, rumen and liver) for the determination of the microbial microbiome will be used to evaluate a potential link of individual pens to liver abscess severity and type (in terms of specific pathogens isolated from the liver abscesses). This information will assist producers to devise strategies around pen and manure management to minimize the occurrence of liver abscesses.

- The Alcalde Sustainable Agriculture Science Center is dedicated to research on sustainable agriculture and related issues to benefit small-scale family farms and ranches of north-central New Mexico. Through testing of different crops, varieties, and production techniques, the Center provides new information that producers can adapt to their own operations for greater productivity and profitability. For example, by enhancing the ability of local growers to have product year-round through use of high tunnels, they are able to pursue additional markets, including school lunches, restaurants, and year-round farmers' markets (such as began in Sante Fe a few years ago). Growers who do this have significantly enhanced their profits. Winter temperatures inside the high tunnels have been found to be at least 20-30 degrees F higher than outside. By enhancing the ability of local growers to have product during more of the year, they may be able to pursue additional markets, including school lunches and year-round farmers' markets. High tunnels (hoop houses) used in this research are relatively inexpensive to build and rely only on sunlight to build up heat inside of the tunnel. Their use has been shown to produce harvests of lettuce, spinach, and kale during the coldest months of the year - December, January, and February. Research is expanding to test summer-cucumber+winter-spinach, and summer-blackberry+winter-kale/spinach for year-round crop rotations in high tunnels.

- Research on acequia agriculture hydrology is documenting the hydrologic benefits to aquifer recharge and groundwater return flow to the river that the local traditional irrigation systems provide. These results reflect research-to-date carried out along the main stem of the Rio Grande near Alcalde, NM, the Rio Hondo near Valdez, NM, and El Rito Creek near El Rito, NM. Our research has shown that decisions to transfer water out of agriculture or significantly change irrigation management in the areas studied can result in reduced seepage and the benefits it provides in terms of aquifer recharge and late-season river flows.

- We have demonstrated an inverse relationship between nitrogen excretion and plasma concentration of branched-chain amino acids in growing steers exposed to an endotoxin challenge. Our research also demonstrated that calves exposed to endotoxin had less nitrogen loss when post-rationally infused with branched-chain amino acids. Furthermore, our feedlot research has demonstrated that ovalbumin-specific immunoglobulins increased when rumen-protected branched-chain amino acids were supplemented to cattle. Based on these results, branched-chain amino acids appear to support immune system function and decrease catabolic protein loss in stressed cattle. We have also conducted research to evaluate the bioavailability of a rumen-protected branched-chain amino acid product to support immune system function

of stressed ruminants. Our research results demonstrated that ruminally-protected leucine and ruminally-protected valine were absorbed by the gastrointestinal tract of sheep, but ruminally-protected isoleucine did not increase plasma isoleucine concentrations. Our previous research demonstrated that supplementation of capsaicin does not reduce inflammation in growing cattle exposed to an endotoxin. The lack of a response to capsaicin in our research is in contrast to anti-inflammatory effects observed in nonruminant studies, possibly due to microbial degradation and low post-absorptive supply of capsaicin from the rumen of cattle. This hypothesis was supported by our subsequent research indicating that capsaicin altered volatile fatty acid profiles and increased gas production by rumen microorganisms in an in vitro batch culture fermentation system. Therefore, capsaicin may be more effective as an anti-inflammatory for ruminant animals if it is protected from microbial degradation in the rumen. Our recent research has demonstrated that development of a rumen-protected capsaicin product may increase the postabsorptive supply of capsaicin in the rumen of cattle. Because previous research has demonstrated that growth of pathogenic bacteria in the gastrointestinal tract is affected by exposure to catecholamines, it is possible that rumen bacteria may respond directly to increases in mammalian stress hormones from the saliva of animals exposed to stressful conditions. Results from this research demonstrated that fermentation and nutrient digestibility are altered when rumen microorganisms are exposed to salivary cortisol and catecholamines in an in vitro system. Other feedlot research results from our group indicated that there are correlations between blood gas parameters and calf health, which imply that blood gas analysis could potentially be used as a diagnostic tool for the early detection of bovine respiratory disease. Researchers have suggested that drinking water could be used as a carrier for essential nutrients for sick animals. Supplementing soluble nutrients via drinking water could increase the nutrients needed during times of anorexia, which typically occurs when young calves are stressed in a feedlot. In a metabolism study, we demonstrated that dissolving glycerin in drinking water did not alleviate the hypoglycemic effects associated with an endotoxin challenge, but did alter rumen fermentation characteristics that favor glucogenic precursors (i.e. increased propionate production). Additionally, endotoxin-challenged steers had greater innate immune responses when supplemented with glycerin via drinking water, which implies that supplying additional energy as glycerin through drinking water may better prepare immune-compromised calves to fight infection.

- Developing alfalfa cultivars that perform well under highly variable soil moisture conditions can help NM hay growers reliably meet the feed demands of the region's dairy livestock industry. The NMSU alfalfa cultivar, NuMex Bill Melton, was developed for hay production in arid and semiarid environments of the southwest that possess high variable soil moisture. This cultivar is a very high performing variety in four NM field test locations. Seed of this variety was commercially marketed in New Mexico beginning in late fall 2015, and 600 acres have been planted to-date. Forage yield of multiple elite alfalfa varieties were evaluated under control (C) irrigation management, flood irrigated every 14-days; deficit (D) management irrigated every 28-days; and early termination (ET) management, irrigated normally for only the first half of each growing season. Relative to the C treatment, average yield reductions of 44% and 46% were observed in the D and ET treatments, respectively, over three years. Variety by irrigation treatment interactions were detected in 2015, but not 2016 or 2017. A significant variety by year interaction was only detected in the ET treatment, and indicated that termination of irrigation during the second half of the 2015 growing season impacted the relative performance of varieties in 2016 and 2017 (post-stress) as compared to 2015 (pre-stress). Results indicate that breeding for resumed productivity after long periods of irrigation termination is needed to maximize farmer management options during drought.

- Based on previous work which identified 25 QTL that influence alfalfa drought resilience, we conducted additional DNA marker genetic fingerprinting of 510 plants from five elite NMSU alfalfa breeding lines. Based on these results, selected plants possessing targeted desirable DNA markers were intermated to develop 30 elite dormant, semidormant, and nondormant alfalfa populations. Three field studies were planted in October 2015 to evaluate these materials. Heavy rain destroyed one field study (semidormant elite) and new seed was regenerated for those 12 populations during 2016 and the study was replanted in fall 2017. Forage yield data from the nondormant and dormant elite populations were collected over six harvests under deficit irrigation management in 2016 and 2017. Four of eight elite nondormant MAS-derived populations exceeded the yield of the elite base population by 1 to 16%. All

eight elite dormant MAS-derived populations outperformed the elite base population by 8 to 51%. Results indicate that the markers we have identified currently have the greatest potential to immediately improve drought resilience of dormant elite alfalfa populations.

- Jujube growing habits and pruning workshop was held at NMSU Los Lunas Center with 26 attendees on March 26, 2016. Most attendees mentioned they had been introduced to a new idea and learned something new about jujubes. Attendees claimed they gained over 50% more knowledge about jujubes than before the workshop (since NMSU is the only U.S. institution to systematically teach jujube growing habits).

- Researchers conducted jujube nutrient analysis (cyclic adenosine monophosphate [cAMP], total phenols and free amino acids) and pollen germination test. Jujubes are famous for their high cAMP content. The cAMP content of mature jujube fruit ranged from 150-350 µg/g DW among cultivars with Don Polenski/Lang as the highest. Jujube fruit was also high in free amino acids, especially proline, which was several times higher than other amino acids. The high proline content may contribute to jujube tree's good stress tolerance and its fruit medicinal effects. For pollen germination, cultivar 'Zaocuiwang' was confirmed as self-sterile without pollen which would be useful for future jujube breeding program as female parent.

- By continuing work with selected populations developed using the inoculation protocol developed from our research, Fusarium Basal Rot resistance in onions might be finally realized. If this developed inoculation protocol proves successful at identifying resistant bulbs, the protocol could be used by other onion breeding programs to develop FBR resistant cultivars.

- Open-pollinated, male-sterile, maintainer, and pollinator breeding lines were screened for disease resistance, bulb yield, bulb quality, maturity date, and bulb color. Promising breeding and hybrid lines and released cultivars were compared to commercial cultivars and experimental lines using variety and observational trials. Autumn and winter-sown trials were placed in growers' fields for evaluation and demonstration. Sixty-seven selections of different lines were conducted this year. Seeds of 450 different lines were produced in this year. This work contributes to the progress of developing a commercial onion cultivar that can be used by growers.

- With previous research suggesting that catnip (*Nepeta cataria*) might be able to repel onion thrips, catnip plants were interplanted with onion bulbs being grown for seed production. In those crossing cages that contained catnip plants in addition to onion plants, fewer juvenile thrips were observed on onion seedstalks at separate dates than in cages that contained only onion plants. In addition, less of an increase in thrips between observational dates was observed in the cages containing catnip plants. When plants were rated for Iris yellow spot severity on seedstalks, onion plants in the cages with catnip were rated as having less severe IYS symptoms than plants in cages without catnip. A similar seed yield per plant was observed for onion plants grown in cages with or without catnip. This research suggests that plants within the Lamiaceae family may be interplanted with onions and a reduction of thrips and IYS symptoms may be observed.

- Alternative cropping systems that reduce or eliminate tillage and use improved crop, soil, and water management strategies were established at the Agricultural Science Center, Clovis in fall 2015/spring 2016. Winter wheat and winter cover crops are planted in October/November each year and spring cover crops are planted in February. Cover crops growth, weed population, soil surface temperature, soil water, soil organic matter, and available nitrogen and phosphorus contents are monitored periodically. Early results of the study revealed that cover crops used soil moisture and available nutrients, added plant biomass, and improved soil microbial activity (measured by in-field CO<sub>2</sub> emissions and by laboratory C mineralization study). We also found that at least five ton biomass input is required to maintain SOC in drylands of the Southern High Plains. The nutrients utilized by cover crops are expected to release during the following main crop growth and support crop production. Comparing tillage systems in a dryland corn-sorghum rotation revealed that reduced-tillage management has improved agroecosystem performance through their effects on soil organic matter dynamics and nutrient cycling.

- A stale seedbed is a set of practices that first stimulates weed seed germination through tillage and irrigation and then eliminates subsequent seedlings with non-selective control. A multi-year field study on stale seedbeds for chile pepper production was completed and analyzed in this reporting period. These analyses included comprehensive cost-benefit evaluations that indicated (1) stale seedbeds cost \$21 to

\$33 acre<sup>-1</sup> to implement in southern New Mexico, and (2) stale seedbeds reduced hand hoeing expenses in chile pepper by \$291 to \$462 acre<sup>-1</sup>. Accordingly, the net effect of stale seedbeds on production expense was a savings of \$258 to \$440 acre<sup>-1</sup>. Providing growers information on the effects of stale seedbeds on labor expenses for chile pepper production might promote adoption of such strategies because: 1) costs and availability of labor are primary constraints on chile pepper production in New Mexico, and 2) adoption of an integrated weed management practice is generally influenced by grower perceptions of the practice's economic value in the context of the local cropping system. Stale seedbeds were also found to reduce weed seedling densities in chile pepper during Run 1, but not Run 2. Variability between runs in stale seedbed effects on weed seedling density may have reflected differences in initial seedbank density.

- Sugarcane aphid was found for the first time in NM in 2015. In 2016 we conducted field trials in Clovis and in Artesia NM to evaluate susceptibility to sugarcane aphid in cultivars that are adapted to NM conditions. Some varieties were identified as being particularly promising. Host plant susceptibility to glandless cotton has been evaluated to develop management tools that will allow us to commercialize this more susceptible cotton. Biological control of pests in glandless cotton has been a focus and we have determined that glandless cotton has similar levels of predation as glanded cotton. There are some differences in types of predators but overall levels of predation are similar. Trials were also conducted in cotton to evaluate seed treatments for control of thrips and varietal resistance to fleahoppers. Recent incursions of pecan weevil into New Mexico are causing concern since NM has been historically free of this most significant pest of pecan. We are planning research trials to support eradication efforts.

- Our research directly impacts livestock and dairy producers as well as couples struggling to have children. Only 50 to 60% of human conceptions advance beyond 20 weeks of gestation. Of pregnancies lost, 75% represent a failure of implantation and placentation. Livestock are not much better. Regardless of 90% fertilization rates in cattle, calving rates to a single fertilization is less than 30% in dairy and 60% in beef cattle, underscoring the need to study embryo attachment and placentation. Embryonic loss remains a major problem for producers threatening overall reproductive efficiency. Indeed, embryonic survival is the major factor affecting production and economic efficiency in livestock meat and milk production. Most embryonic loss occurs during the time frame of embryo attachment to maternal endometrium and early placental development (called placentation). The incomplete understanding of embryo attachment and early placental development is a major limitation to improving pregnancy success in livestock and dairy production systems. The chemokine CXCL12 may be a key player during attachment and placentation because it regulates cell proliferation, migration, and invasion as well as stimulating angiogenesis and immune cell recruitment. All of these biological responses are central to pregnancy success. To enhance understanding of CXCL12 actions we established an innovative in vivo model using sheep to study the placental microenvironment, specifically immune cell populations and vascularization when signaling by the chemokine CXCL12 is compromised. Our model provides an ideal strategy to determine in vivo roles of target proteins, which allows for greater understanding of fetal-maternal communication during implantation and placentation. Inflammatory cytokine expression was also impacted at the fetal-maternal interface as well as systemically when CXCR4 signaling was inhibited at the fetal-maternal interface in ewes during early gestation. We suggest that chemokine signaling affects homeostasis and fetal-maternal tolerance not only in the uterus, but the entire animal. This valuable information will help contribute to ameliorating embryonic loss in the livestock industry through advancing therapeutic developments geared towards altering chemokine signaling either at the fetal-maternal interface or systemically.

- Ruminants are typically born with a non-functional rumen devoid of microorganisms. The succession of the microbial population in the rumen from birth to animal maturity is of interest due to the key roles that the rumen microbial population plays in the overall health and productivity of the host animal. There is limited data available regarding the development of bacterial populations in beef calves housed on pastures. We hypothesize calves raised in differing environments will alter rumen bacterial population development. Results show environmental effects that may be driven by diet quality and composition on the succession of the bacterial population in nursing beef calves. The impact of this research is that producers have options with their cattle that had not been realized. The functionality of the rumen at an early age opens up the opportunity to early wean calves and enhance the reproductive performance of the

cow herd. Increases as small as 10 % can equate to thousand of dollars in revenue to producers.

- Release and registration of the first glandless Acala cotton cultivar Acala 1517-18 GLS: The New Mexico Agricultural Experiment Station announces the release of the glandless 'Acala 1517-18 GLS' cotton (*Gossypium hirsutum* L.) that carries the double recessive glandless genes  $gl_2gl_2gl_3gl_3$ . Acala 1517-18 GLS was an F4:6 line selected from a cross between the glandless trait donor 'Acala GLS' and the glanded 'Acala 1517-08'. This new glandless cultivar was tested in 11 replicated field trials in New Mexico in 2013-2016 and in 14 tests across 11 U.S. states in 2015. Acala 1517-18 GLS produced 93% of the lint yield in Acala 1517-08 across all the tests without observed seed-cotton losses from rodents. But it yielded 30% more lint than Acala GLS. Acala 1517-18 GLS had similar fiber quality to Acala 1517-08 and Acala GLS in fiber length, uniformity, strength and micronaire, but similar or stronger elongation and similar or lower short fiber content. In addition to a higher seed index, Acala 1517-18 GLS had longer and stronger fibers, higher fiber length uniformity and elongation, but lower micronaire and short fiber content than most of the other medium-staple commercial checks. As compared to Acala 1517-08, it was more resistant to *Alternaria* leaf spot [*Alternaria alternata* (Fr.) Keissl.] and had a similar or higher level of resistance to *Verticillium* wilt (*Verticillium dahliae* Kleb.). Acala 1517-18 GLS is adapted to the Mesilla Valley in southern New Mexico and far-west Texas (e.g., El Paso County) where Acala cotton is traditionally grown. Its adaptability in California has not been tested.

- Several greenhouse tests were performed to evaluate for resistance to *Verticillium* wilt (VW) and tolerance to drought and salinity in a panel of 550 MAGIC lines developed from a diallel crossing scheme among 11 Upland cotton lines. Lines with VW resistance and abiotic stress tolerance were selected. In collaboration with two USDA-ARS groups, the results were used in a genome-wide association study (GWAS) to identify quantitative trait loci (QTL) for both abiotic and biotic stress tolerance based on more than 500,000 SNP markers. Consistent QTL were identified, including several for tolerance to both abiotic stresses and two for resistance to both abiotic and biotic stresses.

- Sales of cows and calves are New Mexico's second leading agricultural commodity with sales nearing \$90 million in 2016. Market trends are predicted to continue to put pressure on cattle prices in the coming years. As the cattle market moves from record highs a few years ago, it will be critical for New Mexico ranches to capture as much revenue from their calf crop as possible in order to sustain their operation. Additionally, with increased scrutiny of antibiotic use, it is critical that the cattle industry more broadly adopts Beef Quality Assurance practices to produce healthy animals. Formation of the ACES High certified calf program. The program requires adherence to Beef Quality Assurance practices. In addition, the program acts as a third party verification of vaccination and weaning programs to help producers maximize revenue. Nearly 1000 calves were initially enrolled in the program and 468 calves participated in the NMSU ACES High + certified sale. ACES High + calves on average sold at a higher price than other calves that day. Collectively, participation in the program generated nearly \$34,700 in additional revenue for ACES High + calves compared with calves that had no verification of vaccination or weaning program. During 2016 in New Mexico, 610,000 calves were marketed. If even 10% of those calves were in the ACES High + program and premiums were consistent, then participation in the program would generate nearly \$4.3 million in net revenue from calf sales.

- Although vegetable consumption is critical for a healthy diet, the majority of the population does not eat the recommended daily servings. There is an increasing interest by consumers in locally grown produce because of the freshness, nutritional content and reduced shipping inputs. Training in basic vegetable production, that included methods to optimize soil health, irrigation efficiency, fertilization, and variety selection for New Mexico was presented to beginning Master Gardener groups in key counties in the state. Surveys administered to participants in vegetable trainings reported an increase in vegetable production knowledge, with an average of 71% reporting a large increase in know-how. In addition, an average of 87% of respondents reported being inspired to grow more vegetables. Respondents to program surveys planned to increase the amount of locally grown beans, carrots, garlic, asparagus, lettuce, sweet corn, potatoes and other vegetables as a direct result of the trainings. Planned increases in planned tomato production included: 5,250 lbs in Bernalillo County; 1,980 lbs in Sandoval County; 1,860 lbs in Taos County; 1,110 lbs in Chaves County; 1,830 lbs in Grants County; 1,650 lbs in Los Alamos County; and 4,290 lbs in Valencia County. Overall, only counting surveyed counties, the vegetable production

training will result in 17,970 additional pounds of locally grown tomatoes in the state.

- Despite an investment of roughly \$6 billion in weed management by farmers, weeds which escape management are thought to cause monetary losses of roughly \$4 billion. It has been estimated that in the absence or failure of weed management, losses in corn and soybeans alone might total as much as \$43 billion. In some crops, such as chile in New Mexico, hand weeding is common, which dramatically increases the cost of weed management thus reducing profit. Managing the weed seed bank (viable weed seeds remaining in the soil) can greatly reduce weed pressure and thus increase the effectiveness of weed management strategies. The EPPWS Weed Science program developed practical, ecological tactics for depleting weed seedbanks and educational models that project weed seed costs to promote adoption of these tactics. The program is also expanding conventional options for weed management, such as a Special Local Needs registration for flumioxazin. Seedbank management tactics have the potential to save up to \$300 per acre in hand weeding annually in New Mexico chile production. The concepts developed through this work may be extrapolated to other cropping systems that operate over larger scales. Weed escapes in managed systems currently cost the economy at least \$4 billion. Reducing weed pressure makes current management strategies more effective, thus decreasing the negative impact of weeds on the economy.

- The Livestock Disease and Veterinary Care- NM-ALIRT program is a state-wide network of practicing veterinarians who have been equipped and trained to respond to large or suspicious livestock losses that occur in New Mexico. This program provides a first line defense against disease or terrorism incidents that may threaten the livestock industry of New Mexico. Participating veterinarians report monthly on disease syndromes that will allow for earlier detection of disease trends or outbreaks. This program has expanded to include Arizona veterinarians, who receive education and training alongside NM veterinarians, creating a more regional response to livestock loss. This program has responded to approximately 30 livestock loss situations since its inception in 2006.

- Trichomoniasis became a New Mexico reportable disease in 2005 due to the diagnosis of the disease in a large area of northcentral New Mexico. When the disease was listed as reportable, the incidence of disease among bulls tested was 6.5% positive for the disease. The disease was later found to be present over much of New Mexico. State animal health officials felt it necessary to begin a disease control program to limit the spread of the disease. It became apparent that producer education would be the cornerstone of a Trichomoniasis control program. The NM State Veterinarian asked Extension to lead the development of a Trichomoniasis Control program for New Mexico. The program was developed and instituted in 2006. The program is centered on producer education, and educational programs have been held all over New Mexico. As producers become more aware of the disease, more testing and control measures have been instituted, reducing the disease incidence in the state in 2017 to approximately 1.5% in over 16,000 tested bulls.

- Livestock producers and rural economies recognize the impact of livestock production on the state's economy. Educational programs like the Cattle Growers' Short Course, Southwest Beef Symposium, Cattlemen's College, Ranch to Rail, Beef Quality Assurance, and other events have been used as avenues for the Cooperative Extension Service to better equip livestock producers with disease management and education. These avenues also can be used to educate producers, county agents, government officials, and allied industry members to disease situations, prevention, control and bio-security in New Mexico. Additionally, numerous resources can be published to provide producers information on livestock disease issues. With increased knowledge of producers in livestock disease areas, veterinary resources can be more effectively used by producers. New Mexico has different cultural groups who have unique production issues. These include the numerous Native American cultures across the state and the Hispanic cultures of North Central New Mexico who historically do not utilize veterinary resources. Efforts to introduce producers to the economic benefit of including veterinarians in the management team will result in increased profitability for NM producers.

- As the cattle market moves from record highs a few years ago, it will be critical for New Mexico ranches to capture as much revenue from their calf crop as possible in order to sustain their operation. The ACES High program acts as a third party verification of vaccination and weaning programs to help producers maximize revenue. Collectively, participation in the program generated nearly \$34,700 in

additional revenue for ACES High + calves compared with calves that had no verification of vaccination or weaning program. During 2016 in New Mexico, 610,000 calves were marketed. If even 10% of those calves were in the ACES High + program and premiums were consistent, then participation in the program would generate nearly \$4.3 million in net revenue from calf sales.

- Despite declining resources to teach young dairy professionals modern dairy management, NMSU Dairy Extension leads a consortium of universities to provide a practical dairy capstone course in a 6-week intensive summer training program in Clovis, NM in collaboration with area dairy producers. Total reach in 10-yrs.: 427 students from 48 universities. Impact: 4 out of 5 students employed in agriculture, 2 out of 3 students employed in dairy industry, 1 out of 3 students working on/managing a dairy. Assessing possibilities of replicating program across the US. Program received 2017 Dairy Sustainability Award in Community Partnerships.

- Many New Mexico cattle producers struggle to understand how genetic selection can affect cattle productivity and efficiency. Extension programming can help educate cattle these producers on how they can become more profitable through genetic improvement in their herds. The Tucumcari Bull Test is a long-standing program designed to collect performance data on bulls. Buyers can use this information to make more educated purchases to improve their herd's genetics and to realize improved productivity and profitability. This program now services over 100 cattle producers annually, representing approximately 20,000 head of cattle.

- As of 2016, alfalfa hay remains the most valuable cash crop in New Mexico with an estimated annual gross of \$158 million. Additionally, the forage industry directly influences the success of the livestock and dairy industries. Infestations of late-season perennial weeds that are extremely difficult-to-control with current management options can lower forage quality and yield, increase incidence of disease and insect damage, and create detrimental harvesting issues. New Mexico State University researchers are currently evaluating various herbicides and combinations of active ingredients to help growers better manage difficult-to-control weeds like broadleaf and buckhorn plantain in alfalfa.

- The use of Integrated Pest Management (IPM) strategies is integral to environmentally sustainable pest suppression. Extension education and outreach has focused on increasing grower and homeowner implementation of IPM practices in an effort to reduce pesticide use and increase conservation of beneficial insects. The IPM program at New Mexico State reached over 10,000 stakeholders in 2017, educating growers, land managers and homeowners on the principles of IPM and habitat management for beneficial insects. Impacts showed approximately 66% of stakeholders were currently implementing an IPM practice, while 94% indicated they learned a new IPM tactic they could apply to their system. When stakeholders were asked whether they were actively practicing beneficial insect conservation only 62% indicated yes, while 92% indicated their level of understanding improved in the area of IPM and pollinator conservation.

- Surround crop protectant spray may help New Mexico winegrowers mitigate spring frost damage. Every vintage is different, but "late" frosts that occur after grapes have budded out are a consistent threat across New Mexico each spring. Sometimes, only a week or matter of days is the difference between a full crop, a partial crop or complete loss. New Mexico State University State Researchers are testing a kaolin clay material, for its ability to reduce temperatures of dormant buds. This temperature reduction could slow bud development and consequently delay vulnerable green growth until after the threat of damaging frost has passed.

- With the recent high prices for pecans, there has been increased interest in planting pecan orchards in colder-climate areas of New Mexico where there is an elevated risk for springtime freeze injury. When pecan trees are subjected to freezing temperatures after bud-break there is often total crop loss, costing the grower as much as \$5,000/acre in potential gross profits. NMSU researchers are studying the possible use of white kaolin clay sprays to cool dormant bud tissues, thereby delaying bud-break and reducing risk for freeze injury. This would represent a far less expensive option for mitigating freeze injury risks than installation of wind-machines.

- Turfgrass represents the largest irrigated crop in the US and plays important economic and ecological roles in urban environments. To reduce irrigation water needed to sustain public parks, New Mexico State University's Turfgrass Research and Extension team works with the City of Albuquerque to compare water

use in a park half irrigated with subsurface drip, half with standard sprinklers. First year data indicated that the drip irrigated part used 30% less water, with no drop in visual appearance. The City hopes to install subsurface systems in other parks over the next 3 to 5 years, which could save up to \$1 Million annually in water costs.

- New Mexico produces over 1.2 million tons of hay on over 300,000 acres, and 2.4 million tons of silage on approximately 100,000 acres. Value of these combined forage industries is greater than \$365M/year. Improved farm efficiencies of 25% or more have been shown, through research, to result from selecting proper crop species and variety, fertilizer and seed inputs, and improved water management strategies. These improvements can result in as much as \$100/acre savings to forage producers, with an overall potential impact exceeding \$35M in the state of NM.
- There is an increasing interest by consumers in locally grown produce because of the perceived freshness, nutritional content and reduced shipping inputs. Surveys administered to participants in vegetable trainings reported an increase in vegetable production knowledge, with an average of 71% reporting a large increase in know-how. In addition, an average of 87% of respondents reported being inspired to grow more vegetables. Respondents to program surveys planned to increase the amount of locally grown beans, carrots, garlic, asparagus, lettuce, sweet corn, potatoes and other vegetables as a direct result of the trainings. Information provided on growing tomatoes motivated an increase in local production by 5,250 lbs in Bernalillo County; 1,980 lbs in Sandoval County; 1,860 lbs in Taos County; 1,110 lbs in Chaves County; 1,830 lbs in Grants County; 1,650 lbs in Los Alamos County; and 4,290 lbs in Valencia County. Overall, only counting surveyed counties, the vegetable production training will result in 17,970 additional pounds of locally grown tomatoes in the state.
- Commercial chile acreage in New Mexico has dropped from approximately 36,000 acres in the mid-1990s to the current 8,000 - 9,000 acre range. Much of this decline can be attributed to the cost and availability of labor; NM green chile is a particularly labor intensive crop. NM green chile is completely harvested by hand. Mechanizing the harvest of this crop is key to reversing the loss of production acreage in state. This program has pursued the long-term goal of breeding NM green chile cultivars efficient for mechanization. In collaboration with Agricultural Engineers, research has also been conducted to identify optimum equipment and production protocols. Success in these efforts is expected to spur mechanization of NM green chile and reverse the decline of chile acreage in the state. If only 10 % of green chile acreage lost since peak production is regained as a result of mechanization, the state will realize approximately 19 million dollars of additional crop receipts per year.

## **2. Brief description of the target audience**

The target audience includes: ranchers, feedlot operators, dairy producers, small/medium/large-scale agricultural operations, business, associations, cooperatives, consulting firms and collectives that might or might not be defined as a farm under the USDA economic return criteria, but are land owners, managers, consultants, or students who wish to improve agricultural production and efficiency. Other audience participants include Extension agents, other agricultural specialists, pesticide applicators, Master Gardeners and garden clubs, youth (4H, Future Farmers of America and other groups) and the general public.

## **3. How was eXtension used?**

eXtension was not used in this program

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

### **1. Standard output measures**

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	52336	0	0	0

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

Year: 2017  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2017	Extension	Research	Total
Actual	35	105	140

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

**Output Target**

**Output #1**

**Output Measure**

- The specific output measures will vary according to the specific project being monitored. The development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program.

**Year**                      **Actual**  
 2017                              0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# of trained professionals
2	# of improved animal varieties
3	# of research publications
4	# of methods, technology, and animal varieties adopted by public and private sectors
5	# Extension publications

**Outcome #1**

**1. Outcome Measures**

# of trained professionals

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	25

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

**Issue (Who cares and Why)**

The agricultural disciplines need to replace retiring professionals.

**What has been done**

Graduate students have been trained.

**Results**

New professionals have been graduated.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

- 301 Reproductive Performance of Animals
- 302 Nutrient Utilization in Animals
- 305 Animal Physiological Processes
- 306 Environmental Stress in Animals
- 307 Animal Management Systems

**Outcome #2**

**1. Outcome Measures**

# of improved animal varieties

Not Reporting on this Outcome Measure

**Outcome #3**

**1. Outcome Measures**

# of research publications

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	105

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

**Issue (Who cares and Why)**

The research results published in peer-reviewed journals matter to other professionals in the disciplines, by advancing the knowledge in the discipline.

**What has been done**

Knowledge has been generated and reported.

**Results**

Professionals have a deeper knowledge base from which to draw.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems

**Outcome #4**

**1. Outcome Measures**

# of methods, technology, and animal varieties adopted by public and private sectors

Not Reporting on this Outcome Measure

**Outcome #5**

**1. Outcome Measures**

# Extension publications

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
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**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Extension professionals rely on the information in Extension publications.

**What has been done**

Knowledge has been developed and disseminated.

**Results**

Extension professionals have recommendations and knowledge to disseminate.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
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

**Brief Explanation**

Budget cuts have affected the number of faculty and staff available to generate and disseminate knowledge.

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

The majority of adult program evaluations carried out by New Mexico Extension agents and specialists are pre-post and post-program knowledge gain instruments. The majority of youth (primarily 4-H club) program evaluations are demonstrations of knowledge gained

and applied in teaching others, competitive events, and climbing 'youth career ladders'. Rarely, if at any time, does an agent or specialist report that participant knowledge attained/gained was less than satisfactory. One can only assume that knowledge gain survey questions are fairly worded, and that audience participation was not mandatory. The only exception to this is with Master Gardener and Integrated Pest Management qualification exams. But again, participation is initially by application and the desire to learn and apply what is learned.

### **Key Items of Evaluation**

What is interesting to note is that most Extension faculty now use goal setting, program objectives, and evaluation instruments in their program plans (as opposed to 10 years ago, when there was a great degree of resistance). The next step in program evaluation is to assist Extension agents and specialists to develop precision evaluation instruments. On-going training, such as the Western Extension Cohort (Evaluation) Training (WECT), needs to be organizationally supported and participation needs to be encouraged by all Extension faculty. Also, the American Evaluation Association has an Extension group section and should become a legitimate and heavily encouraged professional Extension association. The Association does more than any other organization to encourage evaluation 'best practices.'

**V(A). Planned Program (Summary)**

**Program # 2**

**1. Name of the Planned Program**

Agricultural Markets, Trade, and Economic/Business 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
511	New and Improved Non-Food Products and Processes	1%		1%	
601	Economics of Agricultural Production and Farm Management	15%		15%	
602	Business Management, Finance, and Taxation	2%		2%	
603	Market Economics	14%		14%	
604	Marketing and Distribution Practices	30%		30%	
608	Community Resource Planning and Development	20%		20%	
610	Domestic Policy Analysis	16%		16%	
611	Foreign Policy and Programs	2%		2%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	4.8	0.0	4.0	0.0
<b>Actual Paid</b>	0.2	0.0	1.0	0.0
<b>Actual Volunteer</b>	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
23332	0	128194	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
23332	0	128194	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**

- Discussions and research of restaurant operators and stakeholders about common mistake, profitability and competitive models took place at the SHRTM Board of Advisors meetings this year, at focus groups arranged at local restaurants and lead to several interesting research threads. In 2016, participants' biggest issue was how to improve customer loyalty through employee engagement and the project director published an article in a handbook on the topic that includes case studies as teaching tool. This also lead to discussions of how to use technology and social media and how these approaches are constantly changing. This theme continued in 2018 as stakeholders voiced interest in ways restaurant operators might market independent restaurants and improve profitability by participating in and creating local and regional Gastronomic Festivals and Events. We created a project to document all events in New Mexico in 2018 with assistance from extension agents throughout the state, which will also survey event managers and directors on their opinions on the future of gastronomic events as well as strategies for success. Trends driving gastronomic events are increased interest fueled by growth in disposable income as well as heightened interest in quality food and beverage. The driver and motivation for the tourists experience is the participant involvement in the gastronomic experience at festivals and events where the fun, food/beverage, and comfort feed the experience producing emotional and evaluative satisfaction. We also found that in New Mexico Specialty agricultural products also drive the success of festivals and also independent restaurants.

- Research examined the feasibility of growing malt barley and processing barley into malt in Southern New Mexico. Information was provided to the New Mexico Department of Agriculture and presented to farmers and other stakeholders. A Microsoft Excel spreadsheet program was developed to assist potential interested farmers in exploring impacts of key assumptions on feasibility assessment.

- Dozen of NMSU faculty, staff and students have actively participated in the NMSU Bi-National Extension Leadership development program over the past four years. NMSU Extension has established itself as a national leader in developing and delivering high valued and effective extension programs to Mexico universities and communities. And most importantly, NMSU Cooperative Extension has gained additional knowledge and skill to serve similar populations in the New Mexico and beyond.

- In today's global marketplace, economic development progress is more likely to be realized when rural and metro counties work together as a region to assess their resources and then design and implement plans that build on their assets and comparative economic strengths. The NM Stronger Economies Together (SET) program facilitates regional planning, collaborative investments, and projects across communities and counties that hold the greatest promise for mobilizing scarce resources to achieve the economic development in rural areas. Growing the economies of communities will increase

employment and income earning opportunities, slow down, and reverse in some cases, the outmigration of the "best and brightest", strengthening the national economy.

- The last three USDA Census of Agriculture data suggest that the average age of farmers and ranchers in the US is increasing and the total number of farmers and ranchers is decreasing. In addition, the number of family farms is also decreasing at an alarming rate. Due to this situation, there is much concern in the US as to who will produce our food in the near future and the extinction of the family farm. Congress has allocated funding over the past three Farm Bills addressing the need to build/grow a new generation of farmers and ranchers. The efforts of the New Mexico Pueblo Beginning Farmer and Rancher Project brings forward contribute to this effort as well as benefit the continuation of the custom, culture and traditions of the first American farmers. Specialists and agents conducted over twenty community meetings at the Northern and Southern New Mexico Pueblos over the years in an effort to recruit beginning farmers and ranchers (BFR) with 10 or less years of managerial decision making experience on their farms and ranches. This group of farmers and ranchers have the highest risk of dropping out of production agriculture. Over 160 beginning farmers and ranchers have been recruited and participate in the program. Once recruited into the program, individual curriculums were developed for these participants and educational programs were developed and conducted by New Mexico CES specialists and agents to fulfill their agricultural educational and technical needs. Over 50 subject matter workshops have been conducted as well as 8 agriculture conferences, 5 regional farm tours, 15 on-farm demonstrations, and over 300 on-farm visits and one-on-one assistance in providing the technical and educational component to this project.

- Since 2015, The "Martin Steinman Endowed Professorship in Food Science and Technology" has supported 11 undergraduate students to work on Extension Food Technology value-added research projects ranging from jerky, artisan cheese and chile processing while utilizing specialized equipment (extruder, spray drier, pasteurizer, freeze drier) for new food product development with glandless cottonseed meal and jujube fruit. These "Steinman Fellow" students successfully completed their degree programs, presented their research projects at a professional meeting, participated in an external internship, joined the food industry or advanced their education. This program develops confident, educated, skilled professionals demanded by the food industry for experience in self-directed successful team projects.

## **2. Brief description of the target audience**

The target audience includes: ranchers, feedlot operators, dairy producers. small/medium/large-scale agricultural operations, business, associations, cooperatives, consulting firms and collectives that might or might not be defined as a farm under the USDA economic return criteria, but are land owners, managers, consultants, or students who wish to improve agricultural production and efficiency. Other audience participants include Extension agents, other agricultural specialists, pesticide applicators, Master Gardeners and garden clubs, youth (4H, Future Farmers of America and other groups) and the general public.

## **3. How was eXtension used?**

eXtension was not used in this program

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

### **1. Standard output measures**

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3873	0	0	0

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

Year: 2017  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2017	Extension	Research	Total
Actual	1	2	3

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

**Output Target**

**Output #1**

**Output Measure**

- The specific output measures will vary according to the specific project being monitored. The development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program.

<b>Year</b>	<b>Actual</b>
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# of research publications
2	# of Extension publications
3	Number of professionals trained

**Outcome #1**

**1. Outcome Measures**

# of research publications

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	2

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

**Issue (Who cares and Why)**

The research results published in peer-reviewed journals matter to other professionals in the disciplines, by advancing the knowledge in the discipline.

**What has been done**

Knowledge has been generated and reported.

**Results**

Professionals have a deeper knowledge base from which to draw.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
603	Market Economics
604	Marketing and Distribution Practices
608	Community Resource Planning and Development
610	Domestic Policy Analysis
611	Foreign Policy and Programs

**Outcome #2**

**1. Outcome Measures**

# of Extension publications

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	1

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

**Issue (Who cares and Why)**

Extension professionals rely on the information in Extension publications.

**What has been done**

Knowledge has been developed and disseminated.

**Results**

Extension professionals have recommendations and knowledge to disseminate.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices
608	Community Resource Planning and Development

### **Outcome #3**

#### **1. Outcome Measures**

Number of professionals trained

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

##### **Brief Explanation**

Budget cuts and retirements have affected the number of faculty and staff available to generate and disseminate knowledge. We are in the process of searching for and hiring new faculty.

#### **V(I). Planned Program (Evaluation Studies)**

##### **Evaluation Results**

The majority of adult program evaluations carried out by New Mexico Extension agents and specialists are pre-post and post-program knowledge gain instruments. The majority of youth (primarily 4-H club) program evaluations are demonstrations of knowledge gained and applied in teaching others, competitive events, and climbing 'youth career ladders'. Rarely, if at any time, does an agent or specialist report that participant knowledge attained/gained was less than satisfactory. One can only assume that knowledge gain survey questions are fairly worded, and that audience participation was not mandatory. The only exception to this is with Master Gardener and Integrated Pest Management qualification exams. But again, participation is initially by application and the desire to learn and apply what is learned.

##### **Key Items of Evaluation**

What is interesting to note is that most Extension faculty now use goal setting, program objectives, and evaluation instruments in their program plans (as opposed to 10 years ago, when there was a great degree of resistance). The next step in program evaluation is to assist Extension agents and specialists to develop precision evaluation instruments. On-going training, such as the Western Extension Cohort (Evaluation) Training (WECT), needs to be organizationally supported and participation needs to be encouraged by all Extension faculty. Also, the American Evaluation Association has an Extension group section and

should become a legitimate and heavily encouraged professional Extension association. The Association does more than any other organization to encourage evaluation 'best practices.'

**V(A). Planned Program (Summary)**

**Program # 3**

**1. Name of the Planned Program**

Sustainable Management of Natural Resources

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	20%		20%	
103	Management of Saline and Sodic Soils and Salinity	5%		5%	
121	Management of Range Resources	20%		20%	
123	Management and Sustainability of Forest Resources	10%		10%	
135	Aquatic and Terrestrial Wildlife	10%		10%	
136	Conservation of Biological Diversity	10%		10%	
405	Drainage and Irrigation Systems and Facilities	10%		10%	
605	Natural Resource and Environmental Economics	15%		15%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	5.9	0.0	16.6	0.0
<b>Actual Paid</b>	0.6	0.0	4.1	0.0
<b>Actual Volunteer</b>	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
67321	0	323902	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
67321	0	323902	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**

- Continuing in the vein of analyses reported last year, we further analyzed relationships between pasture greenness and GPS-derived cattle grazing behavior parameters. We specifically sought to evaluate the hypothesis that cattle foraging activity (i.e., spatial patterns) tracks landscape greenness and assess whether livestock movement patterns are linked with greenness change detected by remote sensors. Daily distance traveled by cows was greater and foraging area expanded during periods with higher precipitation. A regression model including minimum pasture NDVI, rainfall and their interaction explained 81% of the seasonal variation in distance traveled by cows (P<0.01). Cows explored about 81 ha/d while foraging, but tended to explore smaller areas as the pasture became greener (greenup and peak green stages). Cows foraged an average of 9.7 h daily and spent more time foraging with more concentrated search patterns as pastures became greener. These new findings suggest that measurement of vegetation greenness via remote sensing can facilitate meta-analyses of grazing studies conducted at different locations and times of year.
- Research on acequia agriculture hydrology is documenting the hydrologic benefits to aquifer recharge and groundwater return flow to the river that the local traditional irrigation systems provide. These results reflect research-to-date carried out along the main stem of the Rio Grande near Alcalde, NM, the Rio Hondo near Valdez, NM, and El Rito Creek near El Rito, NM. Our research has shown that decisions to transfer water out of agriculture or significantly change irrigation management in the areas studied can result in reduced seepage and the benefits it provides in terms of aquifer recharge and late-season river flows.
- The preliminary seed transfer guideline study located in the Valles Caldera National Park was measured for first year field growth. Measurements will continue for the next two growing seasons before a final report is generated. This three-year data will provide a basic understanding of Pinus ponderosa latitudinal movement in the southwestern US.
- Better understanding of site-specific factors that regulate weed encroachment is needed. Mesa pepperwort (*Lepidium alyssooides*), an indigenous plant species of the southwestern U.S., is known to aggressively occupy desert landscapes affected by high salinity, and to reduce plant species diversity by as much as six-fold. Recent research shows that this species is salt-adapted largely due to its tolerance of high leaf sodium and chloride accumulation. The findings add to a scarce database on soil-related factors governing plant invasiveness, and indicate that soil salinity assessment may be a cost-effective weed predictive and preventative measure for land managers.
- Low rainfall, high evaporation, low quality groundwater, and scarce surface water have created a need for alternate water sources for irrigation. Low quality water needs treated for example using reverse osmosis (RO). However, process produces highly saline concentrate. This study investigates irrigation strategies using RO concentrate as an irrigation source for glycophytes and halophytes. The objectives

were to evaluate the evapotranspiration (ET), leaching fractions (LF), and total above-ground biomass produced under an irrigation water salinity gradient. Control water irrigated plants had higher ET, lower LF and lower DP than saline water irrigated plants. Dry above ground biomass for *A. canescens* and *L. alyssoides* increased, *P. virgatum* decreased. All species tested in this study appear suitable for cultivation using RO concentrate in sand, but *P. virgatum* is less viable in clay. Concentrate reuse for growing salt-loving plants could aid in implementation of inland groundwater desalination in the southwestern U.S. The ion uptake for all six species was measured and was found to be low. This caused increases in soil salinity.

- A study evaluated the effects of irrigation using saline water on the chile pepper (*Capsicum annuum* L.) cultivars AZ 1904, NuMex Joe E. Parker, NuMex Sandia Select, LB 25, and 3441. Salt tolerance of these cultivars was studied at various growth stages including germination, emergence, vegetative growth, flowering and fruiting stages in a greenhouse set up. Increasing irrigation water salinity increased mean germination and emergence time but did not affect the final germination percentage. Final percentage emergence was affected significantly after EC  $\geq 3$  dS/m. Increasing salinity decreased days to flowering, photosynthesis, stomatal conductance, relative fresh shoot and fruit weights, and water use efficiency. Results show that the selected chile pepper cultivars can be irrigated up to an irrigation water salinity level of  $\leq 3$  ds/m. environmentally sound reuse of RO concentrate will encourage desalination in water scarce areas and greenhouse chile cultivation.

- The availability of surface water for irrigation is not sufficient for sustaining agriculture in the southern New Mexico. Increasingly saline groundwater is used for irrigation, which can have severe consequences on the soil quality and sustainability of agriculture. My research group works on the use of brackish water and RO concentrate for growing chile peppers and halophytes. This has generated a lot of interest in the state and has been widely published by various Newspapers. Our strategy towards developing new irrigation scheduling protocols for safe and low cost disposal of RO concentrate can be a key for sustaining agriculture in water starved southern New Mexico as well as other similar arid areas.

- Groundwater contaminant, 1,4-dioxane, requires strong oxidants for cleanup, but treatment is limited by oxidant decay. Hydroxypropyl- $\beta$ -cyclodextrin (HPbCD) was used to stabilize aqueous phase ozone ( $O_3$ ) and prolong oxidation potential. The HPbCD: $O_3$  clathrate complex was observed, which stabilized decay of  $O_3$ . The presence of HPbCD increased the  $O_3$  half-life linearly with increasing HPbCD: $O_3$  molar ratio. The  $O_3$  half-life in solutions increased by as much as 40-fold relative to HPbCD-free  $O_3$  solutions. These results suggest that the use of clathrate stabilizers, such as HPbCD, can support the development of a facilitated-transport of  $O_3$  for treatment of contaminated groundwater.

- Typical cleanup methods for sites with nonaqueous phase liquid (NAPL) contaminating groundwater are ineffective. We developed a benign NAPL injection remediation approach to reduce the aqueous solubility and mass-flux of contaminants. Relatively insoluble hexadecane (HEXDEC) or vegetable oil (VO) was injected into a trichloroethene (TCE) contaminant zone in lab experiments. NAPL-stabilization experiments created significant reductions in TCE concentrations and mass flux due to a combination of both reduced relative permeability and modification of NAPL composition. This study indicated that the delivery of HEXDEC or VO into TCE contaminant source-zones is an effective and novel approach to groundwater contamination remediation.

- We developed an interactive virtual lab as an alternative, low-risk opportunity for learners to engage in science. Students can conduct experiments, collect data, draw conclusions, and even abort a session. In addition to learning the scientific procedures, the online lab prompts exploration in key scientific and mathematical concepts, such as evaluating bias and assessing data quantity and quality. To complement classroom instruction, online lab engages students more quickly than real-world adsorption studies. More importantly, students can reflect, discuss, review, and even fail at their lab experience as part of the process to see why natural processes and scientific approaches work the way they do.

- Using data from a decade-long mark-recapture effort, we discovered that the US population of the rough-footed mud turtle (*Kinosternon hirtipes*) consists of only 134  $\pm$  52 individuals at this point and is highly imperiled. In 1986, 9 aquatic habitats existed for this turtle species. And while one habitat was lost due to draught conditions, 5 were drained by landowners, leaving only 3 habitats. Thus, while climate change does impact this aquatic turtle population, the direct threat of human impact far outweighs climate

issues at this point. Furthermore, we report various ecological (population is skewed towards males and males are larger in size) and habitat (turtles thrive in pond with abundance of underwater logs and they brumate in close proximity to aquatic habitat) information for *K. hirtipes* to aid in conservation efforts for the future.

- To make algae biofuel a viable enterprise, the research has to focus on (a) increasing productivity, (b) finding benefits other than biofuel for algae cultivation, and (c) easier harvesting methods. We have successfully installed algae turf scrubber (ATS) in aquaria in the laboratory, that might be able to aid will all three issues mentioned above. ATS support filamentous algae growing on a substrate that also have the ability to filter the water flowing across them.

- The U.S. Forest Service spent over \$2 billion in 2017 suppressing wildfires, the most expensive year on record. These uncharacteristically large and severe wildfires threatened lives, property, wildlife habitat, and watersheds. However, fire historically acted as a natural thinning agent by reducing fuel build-up, burning small trees, and thinning ladder fuels. Today's forest managers are seeking solutions to these problems using silvicultural techniques, including prescribed fire. New Mexico State University's forestry and fire research program is providing managers with a demonstration area with over 10 years of data were managers can see first-hand how thinning and burning fire-adapted forests builds resilience to insects, disease and wildfire.

- Water is one of the most important natural resources in New Mexico, and it is particularly vulnerable to degradation because of its scarcity and great demand. Water quality is essential for human, ecosystem and economic health. A better understanding of the importance of healthy aquatic ecosystems and of management practices that protect watersheds and water quality is needed. Extension programming efforts targeting a diverse audience, including school children, Master Gardeners, landowners, and Pesticide applicators have increased knowledge and awareness of the importance of water quality. 78% of participants showed improved knowledge, 94% have changed their attitudes toward how their practices impact water quality, and 74% indicated that they intend to change a current practice.

## 2. Brief description of the target audience

Target audiences include:ranchers, farmers, urban landscapers, park departments, state and federal agencies, private homeowners, and recreational users of parks, forests, and waters.

## 3. How was eXtension used?

eXtension was not used in this program

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

### 1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4711	0	0	0

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

#### Patent Applications Submitted

Year: 2017

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

<b>2017</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	20	51	71

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

**Output Target**

**Output #1**

**Output Measure**

- The specific output measures will vary according to the specific project being monitored. The development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program.

<b>Year</b>	<b>Actual</b>
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# of trained professionals
2	# of research publications
3	# of Extension publications
4	% of people adopting NMSU recommendations

**Outcome #1**

**1. Outcome Measures**

# of trained professionals

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	19

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

**Issue (Who cares and Why)**

The agricultural disciplines need to replace retiring professionals.

**What has been done**

Graduate students have been trained.

**Results**

New professionals have been graduated.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
103	Management of Saline and Sodic Soils and Salinity
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

**Outcome #2**

**1. Outcome Measures**

# of research publications

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	51

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

**Issue (Who cares and Why)**

The research results published in peer-reviewed journals matter to other professionals in the disciplines, by advancing the knowledge in the discipline.

**What has been done**

Knowledge has been generated and reported.

**Results**

Professionals have a deeper knowledge base from which to draw.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
103	Management of Saline and Sodic Soils and Salinity
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

**Outcome #3**

**1. Outcome Measures**

# of Extension publications

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	20

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

**Issue (Who cares and Why)**

Extension professionals rely on the information in Extension publications.

**What has been done**

Knowledge has been developed and disseminated.

**Results**

Extension professionals have recommendations and knowledge to disseminate.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
103	Management of Saline and Sodic Soils and Salinity
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
405	Drainage and Irrigation Systems and Facilities
605	Natural Resource and Environmental Economics

## **Outcome #4**

### **1. Outcome Measures**

% of people adopting NMSU recommendations

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
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

#### **Brief Explanation**

{No Data Entered}

### **V(I). Planned Program (Evaluation Studies)**

#### **Evaluation Results**

The majority of adult program evaluations carried out by New Mexico Extension agents and specialists are pre-post and post-program knowledge gain instruments. The majority of youth (primarily 4-H club) program evaluations are demonstrations of knowledge gained and applied in teaching others, competitive events, and climbing 'youth career ladders'. Rarely, if at any time, does an agent or specialist report that participant knowledge attained/gained was less than satisfactory. One can only assume that knowledge gain survey questions are fairly worded, and that audience participation was not mandatory. The only exception to this is with Master Gardener and Integrated Pest Management qualification exams. But again, participation is initially by application and the desire to learn and apply what is learned.

#### **Key Items of Evaluation**

What is interesting to note is that most Extension faculty now use goal setting, program objectives, and evaluation instruments in their program plans (as opposed to 10 years ago, when there was a great degree of resistance). The next step in program evaluation is to assist Extension agents and specialists to develop precision evaluation instruments. On-going training, such as the Western Extension Cohort (Evaluation) Training (WECT), needs to be organizationally supported and participation needs to be encouraged by all Extension faculty. Also, the American Evaluation Association has an Extension group section and should become a legitimate and heavily encouraged professional Extension association. The Association does more than any other organization to encourage evaluation 'best practices.'

**V(A). Planned Program (Summary)**

**Program # 4**

**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
501	New and Improved Food Processing Technologies	50%		50%	
502	New and Improved Food Products	5%		5%	
503	Quality Maintenance in Storing and Marketing Food Products	25%		25%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%		20%	
<b>Total</b>		100%		100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.7	0.0	1.8	0.0
<b>Actual Paid</b>	0.2	0.0	0.0	0.0
<b>Actual Volunteer</b>	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
32479	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
32479	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**

• Little attention has been given to children's and teen's understanding of food handling knowledge and skills, despite their interest in studying food safety, interest in food preparation for themselves and their families, growing responsibilities related to family food shopping and preparation, and future adult roles as caregivers for household members such as infants, young children, and elderly parents. Researchers in NMSU's Department of Innovative Media Research and Extension partnered with researchers at Rutgers University to design an intervention that would address food safety knowledge and skills of youth, coupled with an understanding of effective educational approaches for middle school children. In order to create behavioral and attitudinal changes in youth that prevent foodborne illness, the team designed a computer-based learning game focused on real-life tasks, to enable youth to gain vital safe food handling skills. Research has demonstrated the efficacy of the Ninja Kitchen game in shifting youth knowledge, attitudes and intentions around food safety. Ongoing dissemination and promotional efforts ensure this effective game reaches a large number of players. Between 2012 and 2018, the Ninja Kitchen game has been played more than 2.1 million times. By engaging with teachers and learners online, investigating many angles for promotion, and nurturing relationships with educational distribution channels, our team was able to connect large audiences with the game. The majority of usage took place via the educational portal BrainPOP and its Game Up site, which is used extensively in K-12 schools. Usage of the game directly from NMSU's servers also shows a Monday through Friday, August through May pattern, suggesting that the game is being used primarily in schools. Ninja Kitchen addresses youth food-handling responsibilities and helps youth develop good habits about cooking and storing foods at the proper temperature and avoiding cross-contamination. A study by Rutgers researchers with more than 400 youth demonstrated that the game is effective in improving food safety knowledge, attitudes and intentions among middle schoolers. Prior to playing the game, youth in general did not have much knowledge about food safety practices and how to prevent foodborne illness. After playing the game, middle schoolers knew significantly more about safe cooking temperatures and danger zone temperatures for meat, fish and poultry. They cared more about eating clean and safe food, felt more confident in their abilities to prepare food safely, and were more determined to do so.

**2. Brief description of the target audience**

Target audience includes food processors in Arizona, Colorado New Mexico, Texas, and Utah.

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	273	0	0	0

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

**Patent Applications Submitted**

Year: 2017  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2017	Extension	Research	Total
Actual	1	5	6

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

**Output Target**

**Output #1**

**Output Measure**

- The specific output measures will vary according to the specific project being monitored. The development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program.

Year	Actual
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# of trained professionals
2	# of research publications
3	# of Extension publications
4	% of food processors using NMSU for their food product development

**Outcome #1**

**1. Outcome Measures**

# of trained professionals

Not Reporting on this Outcome Measure

**Outcome #2**

**1. Outcome Measures**

# of research publications

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	5

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

**Issue (Who cares and Why)**

The research results published in peer-reviewed journals matter to other professionals in the disciplines, by advancing the knowledge in the discipline.

**What has been done**

Knowledge has been generated and reported.

**Results**

Professionals have a deeper knowledge base from which to draw.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products

712 Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

**Outcome #3**

**1. Outcome Measures**

# of Extension publications

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	1

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

**Issue (Who cares and Why)**

Extension professionals rely on the information in Extension publications.

**What has been done**

Knowledge has been developed and disseminated.

**Results**

Extension professionals have recommendations and knowledge to disseminate.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

## **Outcome #4**

### **1. Outcome Measures**

% of food processors using NMSU for their food product development

Not Reporting on this Outcome Measure

### **V(H). Planned Program (External Factors)**

#### **External factors which affected outcomes**

- Economy
- Public Policy changes
- Government Regulations

#### **Brief Explanation**

Budget cuts have affected the number of faculty and staff available to generate and disseminate knowledge.

### **V(I). Planned Program (Evaluation Studies)**

#### **Evaluation Results**

The majority of adult program evaluations carried out by New Mexico Extension agents and specialists are pre-post and post-program knowledge gain instruments. The majority of youth (primarily 4-H club) program evaluations are demonstrations of knowledge gained and applied in teaching others, competitive events, and climbing 'youth career ladders'. Rarely, if at any time, does an agent or specialist report that participant knowledge attained/gained was less than satisfactory. One can only assume that knowledge gain survey questions are fairly worded, and that audience participation was not mandatory. The only exception to this is with Master Gardener and Integrated Pest Management qualification exams. But again, participation is initially by application and the desire to learn and apply what is learned.

#### **Key Items of Evaluation**

What is interesting to note is that most Extension faculty now use goal setting, program objectives, and evaluation instruments in their program plans (as opposed to 10 years ago, when there was a great degree of resistance). The next step in program evaluation is to assist Extension agents and specialists to develop precision evaluation instruments. On-going training, such as the Western Extension Cohort (Evaluation) Training (WECT), needs to be organizationally supported and participation needs to be encouraged by all Extension faculty. Also, the American Evaluation Association has an Extension group section and should become a legitimate and heavily encouraged professional Extension association. The Association does more than any other organization to encourage evaluation 'best practices.'

**V(A). Planned Program (Summary)**

**Program # 5**

**1. Name of the Planned Program**

Health and Wellbeing

Reporting on this Program

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
702	Requirements and Function of Nutrients and Other Food Components	20%		20%	
703	Nutrition Education and Behavior	25%		25%	
704	Nutrition and Hunger in the Population	5%		5%	
724	Healthy Lifestyle	25%		25%	
801	Individual and Family Resource Management	10%		10%	
802	Human Development and Family Well-Being	10%		10%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	5%		5%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	2.0	0.0	3.8	0.0
<b>Actual Paid</b>	5.6	0.0	0.0	0.0
<b>Actual Volunteer</b>	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
443043	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
443043	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

- Several citizens of New Mexico were able to receive psychological interventions through this funding period. In addition, several workshops were given to faculty at NMSU and to students in allied health programs. Both individual and family interventions were tested and delivered. In addition, leadership workshops were offered and participants learned leadership through interacting with horses in equine learning activities. The project has created several opportunities for students in the Marriage and Family Therapy program at NMSU to learn about experiential equine practices. This has added to the scope of their program and allowed them to learn additional psychological techniques to work with clients.
- Participants in New Mexico State University's debt management and elimination program, "Feeling Free by Eliminating Debt Quickly!," increased in knowledge, attitudes and skills regarding how to better manage and eliminate their debt. Taking control of debt, the number one cause of financial stress in New Mexico, leads to feeling more in control of one's finances, paying less in interest, and keeping more money in one's pocket each month.
- Nationally, the Chronic Disease Self-Management Program (CDSMP) has shown a \$714 per person savings in emergency room visits and hospital utilization. This equates to a \$364 per person net savings after considering estimated program costs of \$350 per participant. In New Mexico, Cooperative Extension graduated 116 participants in the CDMSP for a potential economic impact of \$82,824 in reduced health care costs.
- A meta-analysis published in The Diabetes Educator in 2009 assessed the value of diabetes education. Patients who use diabetes education have lower average health care costs than those who do not. The estimated cost savings of a diabetes management program is over \$100 per month per participant. This one year of Kitchen Creations programming had a potential cost savings of over \$564,000.
- Since February 2016, NMSU Extension is subcontracted through the NM Department of Health (NMDOH) Diabetes Prevention and Control Program. Cooperative Extension engages in statewide efforts to increase participation in, access to, reach and effectiveness of a menu of evidence-based English and Spanish Chronic Disease Self-Management Programs (CDSMP) for adults of all ages with diabetes and related chronic health conditions, including those living with disabilities. The CDSMP include: general CDSMP, Diabetes Self-Management Program (DSMP), Cancer: Thriving and Surviving Program (CTSP), and Chronic Pain Self-Management Program (CPSMP). Primarily serving southern NM, community workshops have reached close to 125 participants from Catron, Doña Ana, Grant, Luna, Otero, and Torrance counties. Additionally, to increase outreach and capacity, 37 individuals have earned leader certification that enables them to offer local workshops with support from NMSU Extension. Partners include Concillio Campesino del Sudoeste, Inc., community volunteers, county health professionals, Doña Ana Community College, Doña Ana County Health and Human Services, Health and Human Services

Promotora, NMDOH, NMSU Extension, NMSU student interns, and Presbyterian Health Services.

- Stress is associated with chronic disease, poor quality of life, and increased risk of health issues. A program on Managing Stress and Building Resiliency was developed by NSMU Extension Family and Consumer Sciences and delivered to nearly 1,000 people across the state, including employees of the state, middle-school to college level students, collegiate athletes, and community members. Participants in the program demonstrated increases in knowledge, skills, and motivation to better handle stress and engage in practices that enhance resiliency. This program has the potential to improve health-related risks due to stress and enhance the quality of life of New Mexicans.

- The number one cause of financial stress in New Mexico is debt. With the third-highest unemployment rate in the nation, residents might rely on credit, leading to increased levels of debt. New Mexico State University's debt elimination program focuses on helping individuals and families understand their spending, stop going deeper in debt, and begin the process of eliminating their debt. Impacts show that 100% of participants improved their knowledge, attitudes, and skills regarding debt elimination, 93% intended to pay off their debt as soon as possible, and 93% planned to create a debt-elimination plan to accelerate paying off their debt.

- The Center for Disease Control and Prevention estimates that 10.5% of adults in New Mexico (NM) have been diagnosed with diabetes. A study published in Diabetes Care estimated that diabetes/prediabetes costs the state about \$2 billion a year. Extension has partnered with the NM Department of Health Diabetes Prevention and Control Program and 21 other organizations to provide 29 Kitchen Creations cooking schools. Participants learned how to plan meals/snacks that manage carbohydrates and promote heart health. 470 adults have participated in the cooking schools. A post survey provided the following responses: 100% reported that they understand the strategies to plan and prepare healthy meals; 79% reported that they were following three or more of the recommended eating practices.

**2. Brief description of the target audience**

The target audience includes: teenage mothers, low-income families, families suffering social stress, mal- or undernourished families, diabetics.

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	7920	0	0	0

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

**Patent Applications Submitted**

Year: 2017

Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

<b>2017</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	3	5	8

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

**Output Target**

**Output #1**

**Output Measure**

- The specific output measures will vary according to the specific project being monitored. The development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program.

<b>Year</b>	<b>Actual</b>
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# of research papers
2	# of Extension publications
3	# of trained professionals
4	% diabetics adopting NMSU recommendations regarding nutrition

**Outcome #1**

**1. Outcome Measures**

# of research papers

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	5

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

**Issue (Who cares and Why)**

The research results published in peer-reviewed journals matter to other professionals in the disciplines, by advancing the knowledge in the discipline.

**What has been done**

Knowledge has been generated and reported.

**Results**

Professionals have a deeper knowledge base from which to draw.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

**Outcome #2**

**1. Outcome Measures**

# of Extension publications

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	3

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

**Issue (Who cares and Why)**

Extension professionals rely on the information in Extension publications.

**What has been done**

Knowledge has been developed and disseminated.

**Results**

Extension professionals have recommendations and knowledge to disseminate.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
801	Individual and Family Resource Management
802	Human Development and Family Well-Being

**Outcome #3**

**1. Outcome Measures**

# of trained professionals

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2017	14

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

**Issue (Who cares and Why)**

The agricultural disciplines need to replace retiring professionals.

**What has been done**

Graduate students have been trained.

**Results**

New professionals have been graduated.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

## **Outcome #4**

### **1. Outcome Measures**

% diabetics adopting NMSU recommendations regarding nutrition

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.)

#### **Brief Explanation**

Budget cuts have affected the number of faculty and staff available to generate and disseminate knowledge.

### **V(I). Planned Program (Evaluation Studies)**

#### **Evaluation Results**

The majority of adult program evaluations carried out by New Mexico Extension agents and specialists are pre-post and post-program knowledge gain instruments. The majority of youth (primarily 4-H club) program evaluations are demonstrations of knowledge gained and applied in teaching others, competitive events, and climbing 'youth career ladders'. Rarely, if at any time, does an agent or specialist report that participant knowledge attained/gained was less than satisfactory. One can only assume that knowledge gain survey questions are fairly worded, and that audience participation was not mandatory. The only exception to this is with Master Gardener and Integrated Pest Management qualification exams. But again, participation is initially by application and the desire to learn and apply what is learned.

#### **Key Items of Evaluation**

What is interesting to note is that most Extension faculty now use goal setting, program objectives, and evaluation instruments in their program plans (as opposed to 10 years ago, when there was a great degree of resistance). The next step in program evaluation is to assist Extension agents and specialists to develop precision evaluation instruments. On-going training, such as the Western Extension Cohort (Evaluation) Training (WECT), needs to be organizationally supported and participation needs to be encouraged by all Extension faculty. Also, the American Evaluation Association has an Extension group section and should become a legitimate and heavily encouraged professional Extension association. The Association does more than any other organization to encourage evaluation 'best practices.'

**V(A). Planned Program (Summary)**

**Program # 6**

**1. Name of the Planned Program**

4-H and Youth 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
806	Youth Development	100%		100%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	4.9	0.0	0.5	0.0
<b>Actual Paid</b>	4.2	0.0	0.2	0.0
<b>Actual Volunteer</b>	4101.0	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
298599	0	37292	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
298599	0	37292	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

- Researchers have been developing and pilot testing STEM-based, experiential, and inquiry-based climate science lessons and learning activities for middle school-aged students at the NMSU Extension

and Research Youth Agricultural Science Center in Las Vegas, New Mexico. Lesson plans and learning activities developed in Years 1, 2, and 3 are on measuring surface temperatures using infrared thermometers; the greenhouse effect; the hydrologic cycle; the differences between weather and climate and graphing local weather and climate data sets; and using i-Pad Minis to access, analyze, and draw conclusions from local weather station data located on the SC ACIS NOAA website. The researchers received Enchanted Life Foundation grant funding to purchase a weather station for the NMSU Extension and Research Youth Agricultural Science Center and i-Pad Minis for middle school student use in learning activities that tie them into National Weather Service, SC ACIS NOAA, and New Mexico Climate Center climate databases. The hope is to develop and pilot one or two lesson plans and corresponding learning activities on ways to monitor, mitigate, and adapt to climate change in agriculture and natural resources in 2017-2018. Through a mixture of legislative and grant funding, the Center delivers high value programs at a low cost to about 750 youth annually. Research indicates: programs significant l y close the achievement gap for students performing below grade level, science ski ll development is a significant predictor of overall science comprehension, and that youth exposed to the Center model score significant l y higher in agriscience and have significantly higher science scores on State mandated assessments compared to a control school. Indirectly, the community benefits from a more educated populace, access to fresh food that improves quality of life, and a community space for non--formal agricultural innovation demonstrations.

- Forty-eight youth participated in the State 4-H Livestock Judging contest held at the annual State 4-H Conference in July 2017. The winning teams have the opportunity to compete against the other state winning livestock teams around the U.S. In a survey of all the participants in this year's contest, it was noted that there was an increase in knowledge not only in evaluating market and breeding livestock, but also in prioritizing, taking proper notes for reasons, and a better understanding of the overall livestock industry. Livestock judging is just one youth development tool to prepare youth to be successful in the future.

**2. Brief description of the target audience**

Youth ages 5 to 19 are targeted to learn life, leadership and citizenship skills through: Project Work, Special Interest Groups, School Enrichment, Competitive Events, Fairs, Clinics, Workshops, Record Books, Camps, Community Service, Public Speaking, Elected/Appointed Offices, etc.

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5507	0	0	0

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

**Patent Applications Submitted**

Year: 2017  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

<b>2017</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	2	2	4

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

**Output Target**

**Output #1**

**Output Measure**

- The specific output measures will vary according to the specific project being monitored. The development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program. Numbers of students involved in 4-H programs also will be outputs.

<b>Year</b>	<b>Actual</b>
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# of Research publications
2	# of Extension publications
3	# volunteers trained
4	# of professionals trained

**Outcome #1**

**1. Outcome Measures**

# of Research publications

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	2

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

**Issue (Who cares and Why)**

The research results published in peer-reviewed journals matter to other professionals in the disciplines, by advancing the knowledge in the discipline.

**What has been done**

Knowledge has been generated and reported.

**Results**

Professionals have a deeper knowledge base from which to draw.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
806	Youth Development

**Outcome #2**

**1. Outcome Measures**

# of Extension publications

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	2

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

**Issue (Who cares and Why)**

Extension professionals rely on the information in Extension publications.

**What has been done**

Knowledge has been developed and disseminated.

**Results**

Extension professionals have recommendations and knowledge to disseminate.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
806	Youth Development

**Outcome #3**

**1. Outcome Measures**

# volunteers trained

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
------	--------

2017 4101

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

**Issue (Who cares and Why)**

Volunteers are the life blood of 4H and other youth development programs at NMSU.

**What has been done**

All 4H volunteers are trained to properly instruct and lead youth development activities.

**Results**

We have great support in our local communities for youth development programs, as a result of the training and interactions with NMSU Extension professionals.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
806	Youth Development

**Outcome #4**

**1. Outcome Measures**

# of professionals trained

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	12

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

**Issue (Who cares and Why)**

The agricultural disciplines need to replace retiring professionals.

**What has been done**

Graduate students have been trained.

## Results

New professionals have been graduated.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

#### V(H). Planned Program (External Factors)

##### External factors which affected outcomes

- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

##### Brief Explanation

Budget cuts have affected the number of faculty and staff available to generate and disseminate knowledge

#### V(I). Planned Program (Evaluation Studies)

##### Evaluation Results

The majority of adult program evaluations carried out by New Mexico Extension agents and specialists are pre-post and post-program knowledge gain instruments. The majority of youth (primarily 4-H club) program evaluations are demonstrations of knowledge gained and applied in teaching others, competitive events, and climbing 'youth career ladders'. Rarely, if at any time, does an agent or specialist report that participant knowledge attained/gained was less than satisfactory. One can only assume that knowledge gain survey questions are fairly worded, and that audience participation was not mandatory. The only exception to this is with Master Gardener and Integrated Pest Management qualification exams. But again, participation is initially by application and the desire to learn and apply what is learned.

##### Key Items of Evaluation

What is interesting to note is that most Extension faculty now use goal setting, program objectives, and evaluation instruments in their program plans (as opposed to 10 years ago, when there was a great degree of resistance). The next step in program evaluation is to assist Extension agents and specialists to develop precision evaluation instruments. On-going training, such as the Western Extension Cohort (Evaluation) Training (WECT), needs to be organizationally supported and participation needs to be encouraged by all Extension faculty. Also, the American Evaluation Association has an Extension group section and should become a legitimate and heavily encouraged professional Extension association. The Association does more than any other organization to encourage evaluation 'best practices.'

**V(A). Planned Program (Summary)**

**Program # 7**

**1. Name of the Planned Program**

Climate Change

- Reporting on this Program  
Reason for not reporting  
{No Data Entered}

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	0.0	0.0
<b>Actual Paid</b>	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>Actual Volunteer</b>	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

See the section on the Sustainable Management of Natural Resources Planned Program.

**2. Brief description of the target audience**

Undergraduate and graduate students are the target audience.

**3. How was eXtension used?**

{No Data Entered}

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

**1. Standard output measures**

2017	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: 2017

Actual: {No Data Entered}

**Patents listed**

{No Data Entered}

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

**Number of Peer Reviewed Publications**

2017	Extension	Research	Total
Actual	0	0	0

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

**Output Target**

**Output #1**

**Output Measure**

- Conduct classes on climate change.

Year	Actual
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Number of students trained.

**Outcome #1**

**1. Outcome Measures**

Number of students trained.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	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
{No Data}	null

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Economy
- Competing Programmatic Challenges

**Brief Explanation**

{No Data Entered}

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**V(A). Planned Program (Summary)**

**Program # 8**

**1. Name of the Planned Program**

Sustainable Energy

Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	0.0	0.0
<b>Actual Paid</b>	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>Actual Volunteer</b>	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

See the section on the Sustainable Management of Natural Resources Planned Program.

**2. Brief description of the target audience**

Students and producers are the target audiences.

**3. How was eXtension used?**

{No Data Entered}

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

**1. Standard output measures**

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	0	0	0	0

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

**Patent Applications Submitted**

Year: 2017

Actual: {No Data Entered}

**Patents listed**

{No Data Entered}

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

**Number of Peer Reviewed Publications**

2017	Extension	Research	Total
<b>Actual</b>	0	0	0

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

**Output Target**

**Output #1**

**Output Measure**

- Number of students trained.

Year	Actual
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# students trained.

**Outcome #1**

**1. Outcome Measures**

# students trained.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	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
{No Data}	null

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Economy
- Government Regulations
- Competing Programmatic Challenges

**Brief Explanation**

{No Data Entered}

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

**V(A). Planned Program (Summary)**

**Program # 9**

**1. Name of the Planned Program**

Childhood Obesity

- Reporting on this Program  
Reason for not reporting  
{No Data Entered}

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2017	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	0.0	0.0
<b>Actual Paid</b>	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>Actual Volunteer</b>	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>1862 Matching</b>	<b>1890 Matching</b>	<b>1862 Matching</b>	<b>1890 Matching</b>
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
<b>1862 All Other</b>	<b>1890 All Other</b>	<b>1862 All Other</b>	<b>1890 All Other</b>
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

See the section on the Health and Wellbeing Planned Program.

**2. Brief description of the target audience**

Children, youth, and families are the target audiences.

**3. How was eXtension used?**

{No Data Entered}

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

**1. Standard output measures**

2017	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: 2017

Actual: {No Data Entered}

**Patents listed**

{No Data Entered}

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

**Number of Peer Reviewed Publications**

2017	Extension	Research	Total
Actual	0	0	0

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

**Output Target**

**Output #1**

**Output Measure**

- Conduct workshops and classes on healthy food choices.

Year	Actual
2017	0

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

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	# of youth adopting healthy food choices

**Outcome #1**

**1. Outcome Measures**

# of youth adopting healthy food choices

**2. Associated Institution Types**

- 1862 Extension

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2017	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
{No Data}	null

**V(H). Planned Program (External Factors)**

**External factors which affected outcomes**

- Economy

**Brief Explanation**

{No Data Entered}

**V(I). Planned Program (Evaluation Studies)**

**Evaluation Results**

{No Data Entered}

**Key Items of Evaluation**

{No Data Entered}

## VI. National Outcomes and Indicators

### 1. NIFA Selected Outcomes and Indicators

<b>Childhood Obesity (Outcome 1, Indicator 1.c)</b>	
0	Number of children and youth who reported eating more of healthy foods.
<b>Climate Change (Outcome 1, Indicator 4)</b>	
0	Number of new crop varieties, animal breeds, and genotypes with climate adaptive traits.
<b>Global Food Security and Hunger (Outcome 1, Indicator 4.a)</b>	
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.
<b>Global Food Security and Hunger (Outcome 2, Indicator 1)</b>	
0	Number of new or improved innovations developed for food enterprises.
<b>Food Safety (Outcome 1, Indicator 1)</b>	
0	Number of viable technologies developed or modified for the detection and
<b>Sustainable Energy (Outcome 3, Indicator 2)</b>	
0	Number of farmers who adopted a dedicated bioenergy crop
<b>Sustainable Energy (Outcome 3, Indicator 4)</b>	
0	Tons of feedstocks delivered.