2018 Utah State University Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 08/22/2019

I. Report Overview

1. Executive Summary

GLOBAL FOOD SECURITY AND HUNGER

Horticulture

Research Impact: T. Roper has been evaluating diverse woody germplasm for culinary and rootstock uses in the Intermountain West. There was an excellent crop of pistachios in 2018. Alternate year bearing on the female trees was noticeable with individuals that had a good crop in 2017 producing few if any nuts in 2018. Most of the pistachios were small and of modest quality. However, the Asian plant material appears to be hardy in the Intermountain West.

Research Impact: K. Kapheim is examining factors that determine individual variation in reproductive development among wild bees. Her studies have contributed to a change in knowledge regarding the role of juvenile hormone in solitary bees (Nomia melanderi) and social bees (Megalopta genalis). Prior to her study, it was not known how this highly conserved hormone influences reproductive development in solitary bees. It is now known that it has a significant effect on both ovary development and Dufour's gland development in both species. It was also determined that the social environment can mediate these effects in social bees, but not solitary bees. Reproductive suppression of social bees is mediated through effects on hormone pathways. Knowledge regarding the role of overwintering conditions on nutrient stores in the solitary bee, Megachile rotundata, also changed. In addition, there is new knowledge regarding how reproductive hormones and nutrient levels interact with the immune system to influence reproductive development and longevity. Another discovery was that alkali bees do not have many fungal associates, and microbial associates change with developmental stage and experience. Alkali bees acquire most of their microbial associates from the environment, rather than through vertical transmission.

Success Story: The horticulture industry in Utah generates over $1 billion in revenue. Extension horticultural agents provide useful educational materials, develop and implement programs, and respond to questions relating to selection, planting, and maintenance of landscapes, gardens, and efficient water use. Residents contacted the Extension office, attended workshops, listened to radio programs, and read newspaper articles from USU Extension to grow and care for various horticulture plants in landscapes and gardens. Extension provided support to residents on the identification of insects, pests, weeds, and control methods as needed when insect samples were submitted to the Extension county offices.

Success Story: T. Cooper scheduled home visits and called homeowners to provide information on solving problems related to recognizing insects, diseases, and water stress problems. Homeowners increased their understanding of pest and disease control and learned methods to address problems in their landscapes. Cooper worked Extension staff and tribal communities to build 20 raised bed frames for tribal members homes to plant their own vegetables and improve their eating habits.

Success Story: J. Gunnell taught 29 workshops to over 950 individuals about proper pruning practices. In addition, Gunnell facilitated the Thriving Hive Advanced Beekeeping course which was adopted by Salt Lake County.

Crops

Research Impact: B. Bugbee has been investigating the effect of bioavailable silicon (Si) on tolerance to drought and high temperature stress in economically important plants. Silicon is a major component of most soils and is found in significant concentration in plant tissue. Early plant physiology studies were unable to determine conclusively whether silicon was essential to plant growth but for some plants, most

notably rice, it has proved to be important enough to justify fertilizing silicon deficient fields. Studies were conducted on the effect of Si on wheat growth and seed yield components, with and without drought stress. Several previous studies concluded that Si provides more benefits when plants are stressed. No interaction was found with salt or drought stress in these studies, which suggests that unstressed wheat plants benefit as much from Si treatments as stressed plants. The results indicate that the greatest benefit occurs when concentration increases from 0.0 to 0.3 mM. Typical Si soil solution concentrations range from 0.1 to 0.6 mM, which suggests that highly weathered soils, which are low in Si, would be unable to provide adequate amounts of Si to wheat, especially because wheat can actively uptake the Si. Additionally, because there was no statistically significant interaction between stress and Si, growers should see a benefit even when plants are not stressed. These studies indicate that the addition of Silicon increased seed yield and vegetative mass. Wheat with low levels of silicon exhibited twisting of the awns and decreased roughness of leaf surfaces. Silicon also improved water efficiency of drought stressed plants and affected the concentration of many micro- and macro-nutrients in leaf tissue.
Research Impact: G. Cardon has been investigating soil productivity management in Utah and the Western US. For an irrigated alfalfa and rotational crop project, the research culminated in a proposed revision of long-standing fertilizer recommendations for rotational corn silage (the primary rotational crop in the state). After 37 site years over five growing seasons in eight different counties across Utah, only 3 sites showed response to applied nitrogen following alfalfa in both the first and second years of rotation. Sites that were significantly responsive only showed small increases (3 to 4 tons per acre) in yield and were generally involved fields where leaching from excess irrigation occurred. It is clearly possible to reduce the N requirement for first year corn after alfalfa up to 200 units of N per acre without yield reduction. The current recommendation of an N credit of 100 units of N per acre will also be extended to second year corn, where that has not been part of state recommendations in the past. This adjustment to the recommendations is projected to save Utah corn growers up to $6-$12 million for first year rotational corn and half that for second year rotational corn (depending on the percentage of alfalfa acreage in rotation).
Research Impact: J. Carman is conducting cytological and molecular characterization of sexual and apomictic reproduction in Boechera (Brassicaceae). His team has made major progress on proof-of-concept of a staged agricultural technology that could eventually be worth a trillion dollars annually. This technology is based on a natural mechanism, observed in many animals (e.g. aphids) and plants (e.g. rockcress), that switches embryo development, in response to environmental signals, from asexual (apomictic or parthenogenetic, with genetic input from only the female parent) to sexual (with genetic inputs from both a male and female). Environmental conditions that predictively induce switching between apomixis and sex in rockcress were identified. Then next generation sequencing was used to compare expression levels of 27,000 genes from rockcress ovaries sampled during apomictic development with levels in ovaries sampled after they were induced to reproduce sexually. This allowed for identification of metabolic and molecular pathways that cause sex apomixis switching. Subsequently, pharmacological chemicals were identified that have the same metabolic and molecular pathway effects on reproduction as the environmental factors that normally trigger sex apomixis switching. Using multiple chemicals, the current success rate in switching sex to apomixis is 60% for sexual Boechera stricta, 90% for sexual Arabidopsis thaliana and 71% for sexual Vigna unguiculata (cowpea, an important legume crop of Africa). That apomixis does not occur naturally in the legume family (cowpea) suggests that the genomes of many plants may possess conserved capacities for apomixis. The next step is to genetically engineer complete apomixis into sexual crops. The simplest approach would be to make crops obligately asexual except when chemically induced to be sexual (for breeding). This has the advantage of obligate and perpetual clonal seed production without a chemical treatment. Chemicals would then be used only in a breeding setting to induce sex. When fully developed, this technology will cause crop hybrids to clone themselves through their own seed. An attractive aspect of the technology is that it can be adapted one crop at a time. For example, applying the technology to corn could produce a cost savings of ca. $1 billion annually for hybrid corn seed production in the U.S. alone. Wheat and rice currently provide 65% of all human consumed calories. Essentially all world wheat and half of world rice production is obtained from inbred varieties. Experimental hybrids of wheat and rice yield 15% and 30% more grain than the best inbred varieties grown today, respectively, but currently there is no way to produce commercial quantities of the

hybrid seed. The value of the increased yield from such true-breeding hybrids of wheat and rice in the U.S. alone would exceed $34 billion annually (based on 2010-2015 USDA statistics), and the increased rice yield worldwide would provide food for an additional billion people. Once fully developed, this technology will revolutionize food, feed, fiber, and timber production globally. The resulting economic and humanitarian benefits could dwarf those associated with the development of sexually-produced hybrid crops in the 1930s and the green revolution of the 1960s. Significant reductions in fertilizer, pesticide and carbon fuel usage might also accompany the significant increases in crop yields.

Research Impact: F. Messina is studying the colonization of novel crop hosts by pest insects. Many pest insects have a limited range of crops that they can attack, but it is unclear what factors restrict their diet breadth. In addition, pests often undergo surprising or unexpected host shifts, so that a crop becomes newly susceptible to a particular pest, and new management strategies are needed. New evolve and re-sequence techniques were developed in order to determine the genomic basis by which insect pests adapt to new crop hosts. A replicated, reversion experiment was conducted to show that adaptation to a new marginal host involves trade-offs, such that improved performance on an initially poor host (lentil) reduced performance on the ancestral one (mung bean). This work helps to explain why both pest and non-pest insect herbivores tend to specialize on a few types of host plant. Genome re-sequencing revealed that adaptation to lentil was mediated by standing genetic variation at a modest number of independent genes. This work also confirmed that loss of adaptation following reversion to the ancestral host cannot be explained solely by genetic drift, but rather reflects a true trade-off, i.e., certain genes that confer good performance on one host are sub-optimal on the other. Taken together, these experiments greatly improve our understanding of both the mechanisms and consequences of host shifts by herbivorous insects.

Success Story: The agriculture industry employs more than 79,000 people in Utah, and cash receipts from all commodities approximates to $1.66 billion, contributing about 15% of Utah's gross state output. Farmers, ranchers, and agricultural agencies rely on research-based information and technical assistance from USU Extension to make critical agronomic management decisions relating to crop varieties, soil fertility, irrigation water, weed control, and pest and disease control. Agriculturist and elected officials turn to USU Extension to provide educational programs and information needed to diagnose problems, find solutions, and maintain profitability in growing a variety of crops.

Success Story: J. Gale and Extension faculty trained 50 farmers and ranchers at the annual USU Extension Sevier County Winter Crop Workshop in January of 2018. Extension faculty also completed a two-day professional in-service training to improve their response to severe drought conditions in order to assist growers with water conservation practices. Farmers and ranchers had access to crop workshops, radio programs, and personal and electronic contact with Extension. These individuals learned about the importance of periodically having their soil analyzed for nutrients to determine soil fertility needs.

Success Story: T. Cooper worked with farmers in Duchesne County to analyze soil samples since many producers had never tested their fields. Results showed most fields needed varying amounts of P and K. As a result, producers learned about the recommended mix of soil nutrients to increase yields, which positively impacted farm profitability. Cooper worked with producers to identify and control weeds. In turn, producers gained farm management skills and were able to make critical decisions to solve operational problems. Cooper also held a workshop, Farming and Ranching in a Time of Uncertainty, to educate farmers and ranchers about cross breeding systems, calving preparedness, cattle market cycles, and transition and estate planning.

Success Story: R. Patterson created 45 YouTube videos about gardening, calibration, and Russian olive control which was frequently viewed by a wider audience. Patterson actively works with Extension agents in Emery County on Russian olive control research. As a result, the team removed over 160 miles of Russian olive along riparian areas and treated over 350 trees in 2018.

Beef

Research Impact: J. Villalba and colleagues are developing a transformative beef production system in which cattle are fed and finished on tannin-containing legumes. For the finishing phase, heifers were finished on tannin-containing legumes (birdsfoot trefoil-BFT and sainfoin-SAIN) or alfalfa, or 2-way and 3-way choices of all possible combinations of these legumes. Daily gains for the 3-way choice averaged 1.26 kg/d, which is comparable to daily gains achieved in feedlots. Daily gain with the 3-way choice was 23%

greater than 2-way choices and monocultures. Heifers grazing the three-way choice also showed greater intake (5.37% BW) than animals grazing 2-way choices and monocultures (4.65 and 4.41% BW), respectively, suggesting a synergism among pastures. In addition, methane emissions were lower in the 3-way-choice compared with the average of the 2-way choices (162 vs 226 g/kg of gain) and tended to be lower than in all monocultures (205g/kg of gain). Cattle grazing tannin-containing legumes as monocultures or in combinations showed lower nitrogen concentrations in urine and serum than animals consuming alfalfa monocultures (3.15 vs 6.01g/L and 0.15 vs 0.21g/L, respectively), suggesting a shift in the site of N excretion from urine to feces, which reduces N losses to the atmosphere. In summary, diverse combinations of tannin-containing legumes and alfalfa enhance livestock performance over less diverse arrays of forages, yielding the compounded benefits of reduced methane and N emissions. Thus, the proposed tannin-containing legume system has the potential to improve the profitability of beef production for ranchers while reducing environmental impacts.

Success Story: Beef cattle production is a major industry in Utah. However, cattle mostly graze on public land allotments due to a low amount of privately-owned lands. Public allotments are rangelands that vary from lower elevation desert-type environments to higher altitude mountainous settings. Proper nutrition is critical, particularly on winter ranges, as most cattle stay on rangelands all year-long. J. Keyes began the synchronization process for almost 250 head of cattle owned by 7 different beef producers in Utah and works with many others to help them become certified as Beef Quality Assurance ranchers.

Success Story: J. Dallin conducted a needs assessment to better understand the issues and educational needs of Utah beef producers. Results of the needs assessment enabled Extension to plan and implement new programs to meet the needs of ranchers. Evaluation results indicated ranchers were very satisfied with the workshops thus far. In turn, USU Extension developed a strong relationship with Utah producers and ranchers.

Dairy

Research Impact: S. Isom is investigating molecular determinants of successful embryo development in cattle. Fifty-nine genes from eight different functional groups (apoptosis, epigenome modifiers, chaperone/heat shock response, genomic imprinting, metabolism, oocyte-specific, pluripotency, redox regulation) were evaluated in individual oocytes collected from heifers and cows at different stages of lactation. Four genes (GLRX, H19, NDN, and HSPA1A) showed increased expression in single oocytes from heifers in comparison to lactating dairy cows. Seven genes (ACACA, G6PD, CAT, GLRX, GLRX3, SOD1, and EZH2) showed significantly altered expression in oocytes from mature, lactating cows depending on stage of lactation. Six genes (DNMT1, DNMT3B, SUV39H1, HSP90AA1, GLUD1, and GSR) showed altered expression in single oocytes from lactating cows with different beta-hydroxybuteric acid (BHBA) levels, regardless of lactational stage. These results suggest that lactation, energy status, and progression in milk production may cause a sort of metabolic stress that directly or indirectly alters the molecular constituents of oocytes and thereby potentially affects oocyte developmental competence. Thirty-eight genes from five different functional categories (endometrium-specific, chaperone/heat shock, inflammatory response and regulation, and cellular metabolism) were evaluated in endometrial biopsies. Five genes (IL2RA, IL2, CD28, CTLA4, and GATA3) from the inflammatory response and regulation group showed significantly increased expression level in the endometrium of lactating dairy cows in the comparison with non-lactating heifers. Also, four genes from the metabolism group (ACACA, G6PD, SLC16A3, and PTX3) showed significantly increased expression in the endometrium of non-lactating heifers in the comparison with lactating dairy cows. There were three genes (CD28, IL2RA, and IL10) that showed significantly altered gene expression based on metabolic status (high vs. medium vs. low beta hydroxybutyrate) of lactating cows, independent of lactational status. These results suggest that lactation and negative energy balance induced metabolic stress may result in a pro-inflammatory uterine environment that is inappropriate for supporting early embryo development and overall fertility in dairy cows.

Success Story: The USU Extension Forage Marketing and Dairy Relocation Program, "Bring the Cows to the Feed", resulted in a 17.5% increase of Utah's dairy industry to date. The Dairy industry in Utah is now a multimillion-dollar industry that grew steadily since the early 1990's. It is made up of approximately 17,000 cows producing about 339.6 million lbs. of milk annually valued at about $61.1 million. The

program has also created approximately 1,700 direct jobs with $40.2 million annual payroll.
Success Story: Cache County is one of Utah's leading counties in the production and processing of dairy products. Approximately 20 percent of Utah's dairy cows live and produce in Cache County. C. Israelsen and USU Extension faculty hosted several dairy meetings and seminars focused on cow comfort, milk parlor management, and maximizing milk quality. Evaluations of these activities indicated participations were satisfied since Bovine health has dramatically improved. Also, Extension hosted several best management practices workshops that effectively reduced the fly populations in dairies.

Sheep and Goats

Success Story: Pastoral agriculture is very important to the Navajo People. Many families continue to depend on sheep, goats, cattle, and horses for incomes. These animals are also important to their culture and traditions. J. Keyes delivered multiple presentations to Navajo livestock producers, weavers, and spinners in 2018, and worked with the community to develop the wool and weaving industry. Keyes conducted on-site visitations with Navajo youths and elders to preserve the practices of sheep raising, wool production, spinning, and weaving.

Swine

Research Impact: Y-M. Lee and his colleagues are studying viral components involved in Japanese encephalitis virus (JEV) pathogenicity. The goal of their project is to understand how JEV and other closely related flaviviruses cause neurological diseases, a multifactorial process determined by an array of viral components during infection in a susceptible host. Recently developed isogenic virulent/avirulent and cytopathic/non-cytopathic JEVs and their functional cDNAs provide an unprecedented opportunity to investigate the molecular basis of JEV pathogenicity. This research represents an important step forward in expanding understanding of JEV virulence at the whole-organism level and cytopathogenicity at the single-cell level. It strives to broaden understanding of the pathogenicity of JEV and identify novel molecular targets for use in designing and developing effective, critically needed countermeasures for JEV and potentially other pathogenic flaviviruses.

CLIMATE CHANGE AND NATURAL RESOURCE USE

Climate Change

Research Impact: S.Y. Wang has been building a high-density, hydroclimate database from Forest Service survey data. A multi-source snow water equivalent (spring snowpack) data set has been developed and released through the Utah Climate Center. The data comes from multiple sources, including tree ring-reconstructed snowpack funded by this project, and covers from 1850 to the most recent year. Data is provided through a user-interactive map system (https://earth.climate.usu.edu/service/droughtPreditionPages/snowpack.php). Users view the state's map overlaid with "normal" snowpack distribution and can then click on any location to display the evolution/history of spring snowpack at that location.

Water Conservation

Research Impact: C. Flint has been striving to better understanding how various water resource stakeholders in Utah and the Intermountain West articulate and assess vulnerability and change related to water risks and opportunities. Significant results include the following findings: concerns about water resource issues vary across geographic and social dimensions, including strong rural-urban differences; more marginalized social groups (non-whites, women, older residents, and low-middle income groups) perceive a higher risk; coverage of water issues varied over time and across different newspapers in the Intermountain West with more localized issues taking precedence over regionally common issues; local residents place high value on water for essential life sustenance, aesthetics, and recreation and blend historical identities with future concerns about water demand and availability for future generations; key differences in perspectives exist between local leaders and local publics, with leaders more concerned about infrastructural needs; and inter and transdisciplinary approaches are challenging but essential for better understanding of complex socio-environmental systems such as water. The most significant impact of this research has occurred through facilitating knowledge sharing and interaction among water resource stakeholders and between researchers and external partners. This research has resulted in a better understanding of and appreciation for diverse perspectives within and across communities that has informed how local leaders approach water resource planning and management.

Success Story: Utah experienced moderate to extreme drought trends over the past decade. About 53% of Utah's potable water was used to irrigate landscapes. With a growing population, water conservation strategies are critical for sustaining the state's water supply. Water use in landscapes can be reduced by selecting and growing plants better adapted to southern Utah's desert climate. C. Reid introduced the Wonders of Water booth at the second annual water fair in Cedar City, Utah that attracted 381 students, teachers, and volunteers. Attendees learned about water conservation strategies and efficient landscape irrigation techniques. Reid's booth was highest rated at the fair.
Success Story: H. Muntz developed and provided online resources to residents on reading soil moisture meters and other irrigation guidelines. These educational materials helped residents calculate their landscape water needs. As a result, 72% of public participants reduced their landscape water use through effective irrigation strategies after using the soil moisture meter.
Range Resources
Research Impact: M. Conover has been studying the effects of predators on nesting ducks. Of the 193 duck nests that were located: 33% were cinnamon teal nests, 44% were mallard, and 23% were gadwall. Most nests (61%) were depredated; 34% successfully hatched at least one egg; and 6% were abandoned by the hen. The proportion of nests that were successful did not vary by duck species. Thirty-six predators were conclusively identified because they were photographed while depredating a duck nest: 25 raccoons, 9 skunks, one coyote, and one California gull. There was no significant difference in the location of nests depredated by each of these species within the Bear River Migratory Bird Refuge. Based on these research findings, the Bear River Migratory Bird Refuge modified their strategy to manage predators.
Research Impact: J. Stark has assessed the regulation of microbial growth efficiency (MGE) in rangeland soils. Experiments were carried out to look at soil substrate and moisture effects on MGE. Different quantities of 13C-labeled microbial substrates (acetate) were added to soil with different moisture contents and water potentials as acetic acid vapor without adding water. This approach allowed MGE to be measured in dry soils of different textures. Measurements were compared in shaken soil slurries where water potential was manipulated by addition of different quantities of salt. By comparing measurements made in these two soil incubation types, the effect of soil water potential (and the associated adverse physiological effects of microbial desiccation) could be separated from the effect of soil water content (which regulates substrate supply rates through diffusion). Because different textured soils show different water potential - water content relationships, determining the separate effects of these two components of soil moisture on MGE makes it possible to predict the effect of soil moisture on MGE for soils of a wide range of texture. This information is extremely valuable to earth system modelers for their efforts to predict the effect of climate change, including changes in drought frequency, on MGE and ultimately C-sequestration rates. The results of this study showed MGE declines substantially in drier soils; however, water potential (and microbial desiccation) had very little effect on MGE. Instead, virtually all of the decline in MGE at lower soil moisture is due to lower water content and thus diffusional limitation of substrate supply. This finding is good news for modelers, because it appears that across large land areas and regardless of soil texture, MGE can be predicted using soil water content as the driving variable, rather than water potential which is much more difficult to measure.
Research Impact: E. Schupp is studying abiotic and biotic drivers of Utah rangeland plant distribution and recruitment. Results suggest that S. wetlandicus is not a habitat specialist, suggesting that its populations can be augmented by establishment in presently unoccupied areas to mitigate for damage to existing populations during energy development. A successful germination protocol has been developed so seedlings for transplantation can be produced, presumably on a large scale; germination and initial establishment are the bottlenecks. However, evidence suggests that reclamation of well pads, and likely roads and pipelines as well, has been inadequate to create suitable habitat. Together these results are critical for developing management plants to balance energy development and species conservation across 460,009 acres (186,159 hectares) of the Uintah Basin, the region of Utah with the greatest energy reserves. Although an understanding of ecological processes and changes in management paradigms develop relatively slowly, knowledge that has been acquired is contributing to a change in condition of rangeland, and the rural and urban communities deriving diverse values from healthy rangelands.
Success Story: USU Extension actively conducts research on managing rangelands to benefit individual

ranchers and local communities. Ponderosa pine and Aspen trees were planted in enclosures in 2018. C. Reid and Extension faculty collected 67 fire scared trees as part of data collection efforts in 2018.
Success Story: There is a decrease in regeneration and recruitment of Quaking Aspen throughout the West which reduces the diversity of Aspen populations. A reduction of this biotype can result in decreased resource health across the Intermountain West and negatively impact water quality for human and animal consumption. C. Chapman established stable Aspen transects in 2018 and collected baseline data from a random subset of trees. Results were used to treat about 23,000 acres of mixed conifer/Aspen forest to encourage Aspen regeneration and recruitment.

Forest Resources

Research Impact: J. Lutz has been studying the dynamics of Western forest plots. This project generated new knowledge about the spatial arrangement of trees in forests and how that arrangement affects tree growth and mortality. The information is useful to determining mixed-species planting and thinning to increase forest resilience in the face of ecosystem changes. It resulted in a better understanding of the process of tree mortality (and hence forest change) throughout three different forest types and climatological regimes in the West: the Colorado Plateau of Utah, the Sierra Nevada of California, and the Cascade Range of Washington. The data helps quantify the relative effects of climate, wind, beetles, fungus, and tree competition on mortality and forest change throughout the West.

SUSTAINABLE ENERGY

Research Impact: There are no sustainable energy research impacts to report.

CHILDHOOD OBESITY, NUTRITION, AND COMMUNITY SUSTAINABILITY

Childhood Obesity

Research Impact: R. Munger has been studying the relationship between gestational diabetes and risk of orofacial cleft birth defects and fetal programming of obesity and diabetes mellitus. Orofacial clefts (OFCs) occur at a higher rate in Utah than any other state and the reasons are unknown. Obese mothers and mothers with both pre-existing and gestational diabetes have an increased risk of having children with all types of OFCs. Furthermore, mothers of OFC children have elevated levels of leptin, a signaling molecule produced both by fat tissue and by placenta tissues, and abnormal values for biomarkers that define metabolic syndrome, a precursor to gestational diabetes (GDM) and later post-pregnancy diabetes. It was recently discovered that there is evidence of associations between genes known to be associated with GDM and risk of OFCs, hence strengthening the evidence for a causal association between GDM and risk of OFCs. The growing epidemics of obesity and diabetes and the challenge of early detection and treatment of GDM underscore the public health importance of further research in this area. More attention is thus needed for pre-conceptional education and pregnancy planning for mothers-to-be that stresses nutrition education, the early detection and treatment of gestational diabetes, and measures to reduce the risk of gestational diabetes including the reduction of obesity.
Research Impact: H. Wengreen has developed the FIT game, a game-based approach to obesity prevention in children. The FIT Game narrative was further adapted to target the behavior of physical activity in addition to fruit and vegetable intake and was lengthened from 6 weeks to ~ 8 weeks (39 days). Efforts are currently underway to implement a strategy for the FIT Game that would require less effort to run. In this strategy, the progression of the game would be pre-programed to match the progression seen in previous implementations. Doing this would mean that though fruit and vegetable waste would be collected from students every day, the waste would not be measured, and the game would not be programmed according to that number on a daily basis. Making this change would make it easier for schools to implement the game on their own.
Success Story: Over 14% of Utah households are food insecure. These families are at a higher risk of chronic diseases, diabetes, and high blood pressure. Children, Hispanics, and single female-headed households are disproportionately affected by poor diets. USU Extension implemented a comprehensive approach reaching all communities in Utah through various educational methods. Particularly, the Food $ense/SNAP-Ed program addresses issues relating to food insufficiency, obesity, and intergenerational poverty through direct educational programming. About 2,622 SNAP-Ed participants of Utah County benefited from educational programming by C. Merrill and county faculty. Further, the Food, Fun, and Reading Curriculum was developed to educate children on healthy eating behaviors.

Nutrition

Research Impact: A. Benninghoff, K. Hintze and R. Ward are using a multi-generation mouse model to study the impact of a typical Western diet (TWD) on colorectal cancer prevention by green tea. Preliminary data suggests that ancestral exposure to a Western type diet markedly increased colon cancer incidence and disease severity in F3 offspring that were not fed this diet directly. Also, exposure to a TWD over multiple generations markedly exacerbated the disease in F3 offspring as compared to those fed TWD directly. These observations point to the important influence of (grand)parental lifestyle factors on health outcomes in offspring. Put simply, the poor diet of the great-grandparents appears to have influenced cancer development in their great-grandchildren, who otherwise ate a healthy diet.

Research Impact: K. Hintze is testing different animal models for nutrition and chronic disease studies. Notable discoveries are that mice inoculated with bacteria from obese human donors did not gain more weight compared to mice inoculated from lean human and that the mouse microbiome is more heavily influenced by diet than the human donor. His group also demonstrated that certain bacterial taxa, notably Bifidobacteria, are associated with lower tumor burden and that antibiotic use coupled with a poor diet increases colon cancer risk. These findings have resulted in a change of knowledge regarding diet, the microbiome, feeding behavior, and colon cancer.

Success Story: Individuals in low-income households are at an increased risk for health problems due to poor eating habits. The food insecurity rate in Carbon County, Utah is 16.2%, which represents about 3,300 individuals. E. Serfustini delivered Extension programming to Food Bank recipients of Carbon County. Participants were educated on affordable and healthy recipes, food preparation, and general cooking guidelines for healthy meals. Evaluation of the program indicated approximately 50% of the participants implemented the recommended practices by trying new affordable and healthy recipes at home.

Success Story: Hunger, poverty, and unemployment contributes to an increased risk of obesity and chronic diseases. USU Extension aims to educate Utahns on healthy eating practices through the Food and Nutrition Services (FNS). FNS delivers frequent individual, group, and family nutrition education to the public. FNS continuously designs and implements comprehensive, multi-level interventions in all 29 counties of Utah.

Success Story: T. Steinitz and A. Roberts collaborated to provide educational programming to 43 participants of the public about nutrition and cooking over a two-week period. Topics covered were "Meatless Meals", "Salads with Sass", "Pile Your Plate with Plants", and "Stir-Fry". Further, A. Roberts and USU student interns collaborated with a high school to deliver lunch meals twice a month to low-income students. Approximately 60 low-income students received meals on each visit. About 480 lunches were served to these high school students in 2018.

Community Sustainability

Research Impact: K. Hall has been studying farm to school programing. A needs assessment and gap analysis were completed to discover ways to connect farmers and ranchers with food service directors and school teachers. Principals and teachers were interested in knowing whether ranchers and farmers were willing to participate in farm to school activities in their school districts, while many food service directors did not know farmers in their areas, what was grown, and what could be sold to their schools. Additional research with farmers and ranchers was conducted using a follow-up survey. Farmers were willing to provide food products for classroom activities, school taste tests or lunches in the future if they knew about the event, who to contact and what was needed.

Research Impact: Y. Lee has been studying the resilience of small firms following a major natural disaster such as Hurricane Katrina. In one part of this study she assessed community capital as a focus in predicting small firm success after a natural disaster. There was a significant impact of community capital on small firm success after Hurricane Katrina. The findings suggest that both individual community capital and aggregate community capital play an important role in determining small firm success after a natural disaster. Among the community capital, subjective perception about the community was more important in determining the success of the firm than the involvement (participating in business, social and other organizations) and participation in the community. It can be said that the individual community capital (e.g., owners' perceived community capital) significantly increased the levels of perceived business success

after a natural disaster. It is alarming that even after such a large disaster, about 80% of the business owners report that they are not prepared for another disaster. The findings imply that small business owners need to know disaster preparedness and strategies to reduce vulnerabilities.
Success Story: S. Williams of USU Extension is the president of The Alliance for Youth. The alliance coordinates afterschool programs, which often attracts about 500 youth per event. Williams also delivered leadership training programs to 125 school staff using the Discover 4-H Curriculum.
Success Story: M. Albertson hosted a Babysitting Camp which educated young women on starting their own babysitting business, advertising their new business, and caring for children. Participants also learned about handling emergency situations and taking safety precautions. As such, each participant received first-aid and CPR certification from the American Red Cross.

Individual and Family Resource Planning

Research Impact: K. Bradford, W. Robinson and R. Seedall have developed and delivered a 2-session couples' intervention or relationship checkup. The checkup has been found to help couples improve communication and relational satisfaction. Four units have also been developed for online education of couples. The four units address: (1) becoming a better spouse; (2) communication; (3) intimacy and sexuality; and (4) time and conflict management. These modules can be used to help couples improve their relationships and may be used electronically for access in rural areas.
Success Story: E. Serfustini delivered financial planning to 100 participants at the Women's Conference. Serfustini created and disseminated marriage packets with Extension publications to 472 newlyweds. These packets covered topics such as maintaining relationships, managing a household, family budgeting, and home gardening.
Success Story: D. Schramm developed the Strong Parents, Stable Children training, and Extension faculty delivered the training throughout Utah. M. Albertson delivered the training to 363 individual participants and 43 agency participants in 2018. Evaluation results indicated participants valued the information provided in the training. Albertson also hosted a mini conference, Date Your Mate Celebration, for 289 participants in 2018. Given a high national divorce rate, the mini conference aimed at educating participants about creating and maintaining safe and healthy relationships with families. Evaluation results indicated participants intended on adopting many of the recommended practices such as increasing time spent together with their mates and using effective communication strategies.
Success Story: M. Johnson delivered the VITA program to help families prepare annual taxes. In addition, Johnson also worked with senior citizens and some small business owners to file taxes. Meanwhile, Extension staff from Grand and Utah Counties used Taxslayer to prepare tax returns for 126 households, including 31 senior citizens, during the 2018 tax season.

Youth Development

Research Impact: A. Austin has been studying rural preschool children's mathematical skills, self-regulation, and home and care environments. Her research shows that teachers' ratings carry greater weight than parent ratings. Some researchers feel that preschool executive functioning skills promote mathematics skills, but mathematics skills do not promote executive function skills. Further, many researchers feel that children's understanding of numbers, counting, and simple arithmetic problems is unrelated to their ability to "do" geometry (shapes and area). The current study showed that just about everything is related to everything else with one important exception. Children's number skills in the fall predicted their number skills, geometry skills, and executive function skills in the spring. Children's executive function skills in the fall predicted their executive function skills and number and geometry skills in the spring, but similar to previous researchers, children's geometry skills in the fall only predicted their geometry skills in the spring. Therefore, speaking only with regard to mathematics, number skills predict number and geometry skills, but geometry skills only predict geometry skills.
Success Story: 4-H clubs were implemented by afterschool leaders in all 13 YMCA afterschool clubs and the Utah Military Academy. Evaluation of these programs indicated youth experienced an increase in all dimensions of their social-emotional skills (i.e. self-awareness, self-management, social awareness, relationship skills, personal responsibility, decision-making, goal-directed behavior, and optimistic thinking). Further, results showed a significant improvement in participants' peer relationships, work habits, and social skills.

Success Story: STEM programming was implemented to help youth increase their science abilities and better prepare them to enter the workforce. Multiple efforts have been made to increase science opportunities for youth through partnering with schools, community organizations and the local libraries. Evaluation results showed youth believed they had the ability to "teach someone else about subject of the workshop." Further, youth participants indicated "they want to learn more about science", "they are good at science," and they would "tell their friends to take the workshop" after attending science workshops.
Success Story: Cache Makers connects youth to skilled mentors for hands-on STEM experiences. Project areas included computer programming, digital design and production, and robotics, electronics, and mechanics. These projects gave youth the opportunities to explore their STEM interests, participate in a community of makers and innovators, and prepare themselves for rewarding careers. S. Williams and 4-H faculty served 650 youth in 2018, resulting in a total unique youth served through 1-week summer camps and 6-week school-year clubs to 1108. This figure surpassed the TANF Grant goal of 1000 youth over 3 years. The club has expanded participation to groups often underrepresented in STEM fields through all-girls groups, Spanish outreach, free community events, and affordable offerings for low-income families.

Nutrition and Behavior

Success Story: D. Christense delivered 43 classes to youth and adults on nutrition and diets. Monthly classes were provided to Valley Mental Health, Assisted Living, disadvantaged youth, teen center, and an afterschool program. Classes included Celebration Meals, Farm Fresh, and the Breakfast, Lunch and Dinner series. Christense also developed partnerships with Tooele County Food Drop and local food banks. Social Campaigns were implemented to disseminate information on healthy eating behaviors to the wider public throughout the year.

FOOD SAFETY

Research Impact: M. Walsh and S. Martini are studying the use of a combination of ultrasound and pasteurization (thermosonication) to improve the microbial quality of milk. To determine the effectiveness of thermosonication, raw milk was left at room temperature to increase the microbial load and then treated by pasteurization or thermosonnication. Aliquots were stored at 4 C in sterile containers for 6 weeks and microbial counts were done weekly. Samples treated only by pasteurization had drastically higher microbial growth after two weeks compared to thermosonicated samples. Raw milk treated at a slower flow rate with longer pasteurization and sonication times had significantly lower microbial counts than milk treated at a faster flow rate with shorter pasteurization and sonication times. This study demonstrated that thermosonication is an effective way to reduce the microbial content of milk and improve shelf life.
Research Impact: L. Bastarrachea, D. Britt and C.W. Chang are studying the use of bioactive materials for antimicrobial and cell immobilization applications. They have mixed Polypropylene (PP) with polypropylene-graft-maleic anhydride (PP-g-MA) to obtain a reactive blend (referred to as PP/PP-g-MA) and render it antimicrobial by the application of the polycation ε-poly(lysine) and styrene maleic anhydride copolymer (SMA) onto its surface through reactive blending. The resulting antimicrobial plastic (referred to as PP-SMA-PL) was effective in aqueous suspensions against Escherichia coli K12 ATCC 47009 with or without UV-A light irradiation providing >99.99% reduction in the microbial population, and against the same bacterium in apple juice providing90% reduction under UV-A light. In addition, PP-SMA-PL showed effectiveness against Listeria innocua L2 inoculated in milk in a storage study under refrigeration for 21 days, providing 90% reduction as compared to the starting level of inoculum and 99.99%-99.999% lower microbial load as compared to the control inoculated milk at the end of the storage study. Scanning electron microscopy, energy dispersive X-Ray spectroscopy, infrared spectroscopy, and colorimetric analyses confirmed no deposition of bacteria or organic matter onto PP-SMA-PL during the storage period with milk, as well as no release of ε-poly(lysine) from the surface of PP-SMA-PL. These results suggest that this approach and material have potential applications in food processing, preservation and storage.
Success Story: M. Memmott taught 21 educational classes, workshops, booths, and camps to 1,130 adults on nutrition, health and wellbeing, food preservation, food safety, and food storage. Home preparation and food safety classes were also provided to county residents. Evaluation results indicated an increase in participants' knowledge of food safety practices.
Success Story: Extension programming in food safety and food preservation in 2018 have directly

impacted 876 people. USU Extension collaborated with the Wasatch Front on the Master Food Preserver classes. Train-the-trainer classes were successfully provided to 169 professionals throughout Utah and the Mountain West region.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	102.0	0.0	53.9	0.0
Actual	90.3	0.0	49.9	0.0

II. Merit Review Process

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

- Internal University Panel
- External University Panel
- Combined External and Internal University Panel
- Expert Peer Review

2. Brief Explanation

Agricultural Experiment Station: The scientific peer-reviewed process within the agricultural experiment station involves two steps. Prior to submission to the experiment station, the PI's department head reviews and signs off on the proposal. Once the proposal reaches the station, two scientific peer reviews are obtained from subject matter experts, either from other on-campus faculty (if the expertise exists) or off-campus faculty (if on-campus expertise does not exist). If there is a conflict between these two reviews, an additional peer review is sought. These anonymous external reviews are returned to the experiment station and the PI's are asked to respond to issues raised by these reviewers. The PI then modifies her/his proposal to address the issues raised by the "outside" reviewers before resubmitting it to the experiment station for funding consideration. The practice of sending reviews off-campus to qualified subject matter experts is used approximately 5%-10% of the time.
Utah Cooperative Extension Service: Extension provides the public, primarily within the state, with research-based information and other university resources. Documentation supporting extension performance include peer evaluation and may include, but is not restricted to: active programs with various extension constituents; recognition by extension clients for an effective effort; innovative techniques; effective use of the media; publications appropriate to the assignment; responses to requests from private and government entities for advisory help and consulting; publications in peer-reviewed and/or professional media; service on professional committees, panels and task forces; and peer recognition of the value of the extension effort.

III. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups

- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public

Brief explanation.

Media sources are frequently used by Utah counties to encourage county residents to participate in public meetings and listening sessions. Use of local newspaper and radio resources through public service announcements and paid advertisements are the two primary techniques applied in media use. Counties target traditional stakeholders through letter/poster invitations to participate in public meetings and listening sessions. Such announcements are often placed in public places, on bulletin boards, and other locales frequented by traditional audiences. Nontraditional stakeholder groups are also specifically invited to participate in public meetings and listening sessions through various public and private invitations. Inviting individual stakeholder and non-traditional stakeholder individuals to participate in public meetings and listening sessions is also a significant means of engaging them in discussions. Surveys serve as another means for contacting stakeholders, traditional and nontraditional. For the experiment station, research scientists, often with an extension appointment, work with extension leaders to ensure that ample stakeholder participation is achieved. Even faculty with primary research appointments and strong industry affiliations often provide a unique perspective about different audiences that should be cultivated or developed. Advisory groups, both at the county and university levels, are utilized in obtaining stakeholder input.

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
- Open Listening Sessions
- Use Surveys

Brief explanation.

The Utah Agricultural Experiment Station used many of the same advisory groups used by Extension that meet as needed to provide critical input from public and private sectors. Listening groups with key constituents were also utilized. Utah Extension utilized advisory committees as the primary means of identifying stakeholder individuals and groups to collect program input. Council and advisory groups utilized groups, such as teen councils, horse and livestock councils, Workforce Services, Inter-agency Coalitions, community religious leaders, United Way, Utah State Advisory Boards, Utah Fair Boards, Utah Farm Bureau and Farmers Union Boards, after-school coalitions and previous recipients of Extension programs were also utilized. Counties used focus groups and open listening sessions as means to identify group and individual stakeholders. Needs assessments and surveys provided another primary means of identifying individuals and groups.

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

1. Methods for collecting Stakeholder Input

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

Brief explanation.

Input received from stakeholders has been utilized to redirect Experiment Station and Extension programs, to gather information on emerging issues, and to set priorities as a unified Extension and Experiment Station organization. With an ever growing Metro population along the Wasatch front in Utah, this input has been valuable in redirecting Extension and Experiment Station program emphasis areas to reflect the needs of Metropolitan populations. These inputs frequently inform Extension by influencing recruitment and hiring practices and the informing Extension on the types of applied research stakeholders perceive as critical to their need. The Experiment Station uses stakeholder input provided by Extension and advisory groups to change its research programs. As evidenced by existing and past hiring patterns, the Experiment Station has been changing program emphasis as open positions allow and/or through newly funded positions. Operating and graduate student funds go with those newly funded faculty positions.

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.

The input received from stakeholders was utilized to redirect Experiment Station and Extension programs, to gather information on emerging issues, and to set priorities as a unified Extension and Experiment Station organization. With an ever growing metro population along the Wasatch Front in Utah this input has been valuable in redirecting Extension and Experiment Station program emphasis areas to reflect the needs of metropolitan populations. These inputs informed Extension through influencing recruitment and hiring practices and on the types of research that stakeholders perceive as critical to their need. The Experiment station used stakeholder input provided by Extension and advisory groups' input to make changes in the research program through alternative

funding measures and new faculty hiring. The Experiment Station has been changing program emphasis as open positions allow and/or through newly funded positions. With those funded positions go operating and graduate student funds.

Brief Explanation of what you learned from your Stakeholders

Most stakeholders are still tied to specific program areas although they are interested in all programs offered through USU Extension and the Experiment Station. Information related to home horticulture and organic gardening for food production are important to the general public. Agricultural sustainability, including marketing, weed control, crop management and animal health issues, are important to agricultural producers and these areas are supported by both the Experiment Station and Extension. Production and marketing issues are still critical to agricultural producers and require both Extension and the Experiment Station resources. The economics of various new technologies or production techniques continue to be important research topics for the Experiment Station and Extension. Basic home making skills including food preservation/preparation, food safety, nutrition and sewing are important to home makers and are supported extensively by Extension and, to a lesser extent, the Experiment Station. Families and individuals are in need of food and finance programming which require both Extension and Experiment Station input. Youth leadership development and continuation of traditional 4-H programs such as livestock, horse, sewing, cooking and others are important and stakeholders want to make sure these programs stay alive and viable and are supported primarily through Extension. Most users of USU soil testing service and climate information value these services and want them to continue. The Experiment Station is involved in a host of research issues related to natural resources and the environment including climate change, public lands, water resources, urbanization of productive farmland, etc. -- all areas of critical importance to the citizens of the state of Utah. We have discovered that the public makes little, if any, distinction between Extension and the Experiment Station and likes USU to be available to help with a wide range of issues. Individual members of the public are always concerned as to why their important issues are not the highest priority with Extension and the Experiment Station, not realizing that there are inadequate resources to support all needed help. As a system, we understand that we cannot be all things to all people.

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. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1752365	0	2372516	0
Actual Matching	1752365	0	2372516	0
Actual All Other	0	0	10503217	0
Total Actual Expended	3504730	0	15248249	0

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%		6%	
202	Plant Genetic Resources	0%		3%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		5%	
205	Plant Management Systems	55%		7%	
211	Insects, Mites, and Other Arthropods Affecting Plants	4%		8%	
213	Weeds Affecting Plants	6%		0%	
215	Biological Control of Pests Affecting Plants	0%		2%	
216	Integrated Pest Management Systems	9%		2%	
301	Reproductive Performance of Animals	0%		10%	
302	Nutrient Utilization in Animals	0%		3%	
303	Genetic Improvement of Animals	0%		2%	
304	Animal Genome	0%		7%	
305	Animal Physiological Processes	0%		2%	
307	Animal Management Systems	26%		3%	
311	Animal Diseases	0%		5%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		2%	
603	Market Economics	0%		6%	
902	Administration of Projects and Programs	0%		8%	
903	Communication, Education, and Information Delivery	0%		3%	
990	Unclassified	0%		16%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	23.0	0.0	23.0	0.0
Actual Paid	23.9	0.0	24.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
463211	0	1181623	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
463211	0	1181623	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4900968	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

1. Conduct research experiments with livestock and plants and plant material.
2. Publish studies and make presentations related to plant propagation and livestock reproduction and plant and livestock production.
3. Conduct workshops and meetings to educate local, state, and regional stakeholders concerning progress in producing livestock and plants that are economically viable and environmentally friendly.
4. Provide new methods of livestock pest control and disease prevention.
5. Release new plant varieties relative to this program area under plant variety protection (PVP) status.
6. Expand use of Integrated Pest Management (IPM).
7. Provide pest diagnostic assistance and management information to county agents, state and federal partners, commercial agriculture and horticulture producers, and the general public through the Utah Plant Pest Diagnostic Laboratory.
8. Coordinate efforts with other states and the Western Region Pest Management Center (WRPMC).
9. Enhance the USU Master and 4-H Junior Master Gardener Programs.
10. Utilize multiple demonstrations/applied research plots to manage weeds in agronomic crops with results reported at field days, workshops, or annual meetings.
11. Conduct research experiments and develop theories that can be used to enhance plant and animal productive efficiencies through the use of genomics.
12. Publish studies related to these areas of concern.
13. Conduct workshops and meetings for other scientists involved in this area of research.
14. Develop applications for the research on plant and animal genomics to directly benefit producers and other scientists.
15. Conduct market tests to determine the price premium associated with alternative production and marketing programs.
16. Build models to quantify the impacts associated with international trade.
17. Develop risk reduction models for agricultural producers.

18. Analyze firm-level decisions to identify specific changes that might be made on individual farms and ranches that would enhance net returns.

19. Provide outreach to agriculture businesses, small manufacturers, and entrepreneurs to provide educational training and in-depth information on: small business management, home-based businesses, main street community programs, business retention and expansion, rural and heritage tourism, rural and economic development activities, E-commerce programs, community entrepreneurship, marketing (market feasibility, research, customer relations/service, pricing), finances (recordkeeping, raising capital, growing/expanding financial issues), business plans for potential business owners, patents/trademarks/copyrights, insurance, zoning, and legal requirements, identification of business opportunities, and youth entrepreneurship programs.

2. Brief description of the target audience

The target audience for this work would be other scientists, agricultural producers, general public, home owners, green industry officials, professional landscape managers, turfgrass sod producers, local and regional livestock (primarily beef, dairy and equine) producers, small acreage owners, veterinarians, USDA, other private businesses, and government entities that conduct work in this area.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	192536	186303	26718	25853

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	127	127

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of clientele who gain knowledge about improved human, plant, and animal management systems.
2	Number of clientele who implement improved human, plant, and animal management systems.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	28013

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Beef and dairy production are major industries in Utah. The profitability and wellbeing of livestock owners depends on their ability make critical decisions and efficiently manage cost of inputs. Issues such as genetic improvement, nutrition, forage diversity, efficient reproduction, financial resource management, labor supply, and waste management affect livestock owners? ability to operate a successful business. There is a need to ensure livestock owners are knowledgeable on the issues and factors affecting their operations.

What has been done
A total of 411 participants managing approximately 7,400 head of livestock attended the Range Livestock Workshop.

Results
Most participants (91%) reported greater awareness of the issues affecting the livestock industry, about 93% stated they gained new knowledge, 81% indicated they gained new skills, and 71% stated they modified their attitudes towards the problems facing livestock owners. About 80% of the participants indicated an intent to adopt the best practices discussed in the program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems

211	Insects, Mites, and Other Arthropods 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
303	Genetic Improvement of Animals
304	Animal Genome
305	Animal Physiological Processes
307	Animal Management Systems
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
603	Market Economics

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	9391

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Farmers and ranchers must explore ways to efficiently utilize natural resources, manage production costs, and maintain profitability. There is also a need to improve the health of wildlife and rangeland to support ecosystems while providing forage. Research have contributed to identification of new species of forage and alternative strategies to increase forage production. Research is targeted to improving conditions for farmers and ranchers, therefore, it is critical farmers and ranchers implement these best practices to maintain or improve their productivity and profitability.

What has been done
In 2018, 125 producers attended the Box Elder County Crop School.

Results
Producers learned how to properly manage arthropods pest in alfalfa fields and select the most effective insecticide and herbicides to use in controlling insect pests in alfalfa. They understood the importance of rotating pesticides to reduce pest resistance. The success of the Crop School led to strong partnerships with private industry representatives to disseminate the information to a larger audience through new train-the-trainer and individual workshops.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods 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
304	Animal Genome
307	Animal Management Systems
603	Market Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Most participants (91%) reported greater awareness of the issues affecting the livestock industry, about 93% stated they gained new knowledge, 81% indicated they gained new skills, and 71% stated they modified their attitudes towards the problems facing livestock owners. About 80% of the participants indicated an intent to adopt the best practices discussed in the program.
Producers learned how to properly manage arthropods pest in alfalfa fields and select the most effective insecticide and herbicides to use in controlling insect pests in alfalfa. They understood the importance of rotating pesticides to reduce pest resistance. The success of the Crop School led to strong partnerships with private industry representatives to disseminate the information to a larger audience through new train-the-trainer and individual workshops.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change and Natural Resource Use

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	0%		4%	
102	Soil, Plant, Water, Nutrient Relationships	3%		14%	
104	Protect Soil from Harmful Effects of Natural Elements	0%		3%	
111	Conservation and Efficient Use of Water	0%		12%	
112	Watershed Protection and Management	21%		1%	
121	Management of Range Resources	14%		12%	
123	Management and Sustainability of Forest Resources	3%		8%	
131	Alternative Uses of Land	0%		2%	
132	Weather and Climate	0%		9%	
133	Pollution Prevention and Mitigation	0%		3%	
134	Outdoor Recreation	0%		3%	
135	Aquatic and Terrestrial Wildlife	24%		1%	
136	Conservation of Biological Diversity	0%		6%	
205	Plant Management Systems	14%		4%	
206	Basic Plant Biology	0%		1%	
213	Weeds Affecting Plants	7%		1%	
306	Environmental Stress in Animals	0%		3%	
307	Animal Management Systems	0%		3%	
605	Natural Resource and Environmental Economics	14%		7%	
723	Hazards to Human Health and Safety	0%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	19.1	0.0
Actual Paid	16.4	0.0	16.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
318700	0	670619	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
318700	0	670619	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3669692	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

1. Continue to facilitate and assist the establishment and success of local Conservation Resource Management (CRM) groups, for more local control of decisions on natural resources.
2. Educate the public with respect to the principle causes of air pollution and their role in prevention.
3. Partner with others to enable agriculture producers to meet EPA requirements.
4. Establish herbicide demonstration/research plots to evaluate the efficacy of these products under local conditions.
5. Conduct projects consultations, and workshops focusing on the role of outdoor recreation and natural resource-based tourism in relation to community development.
6. Partner with others in education and use of resources to rehabilitate the sagebrush steppe environment.
7. Educate and partner to enable the recovery of the sage grouse, pygmy rabbit and others to avoid listing as endangered species.
8. Determine management options that slow or stop the cycle of cheatgrass and fire on previously burned areas through range rehabilitation, seeding programs and nontraditional approaches to grazing management.
9. Educate producers and agency personnel on the need for continued range evaluation, monitoring, and management improvements and the role of grazing management in sustainable resource management.
10. Educate the public on responsible use and the value of multiple uses on rangelands.
11. Illustrate the need for management and control of pinion-juniper forests to restore watershed, wildlife habitat and forage values on rangelands.
12. Educate the public regarding various options with respect to adapting to global climate change
13. Provide information to landowners and users on grazing management of grazeable lands.
14. Partner with and educate the general public, livestock producers and agency personnel on the identification and methods of control of the specific noxious and invasive species.
15. Conduct experiments and develop theories that can be used to enhance water, soil, wildlife, and

for various agronomic and urban areas.

16. Publish studies relating to this program area.

17. Provide educational training, problem solving, and in-depth applied information to: facilitate rehabilitation of degraded watersheds, protect and manage watersheds, conserving, managing and enhancing efficient water use, derive efficient irrigation strategies and technologies, implement water-wise landscaping practices, evaluate and promote plants that require less water and are drought tolerant, preserve and enhance water quality, enhance quality, capture, and use of storm-water and gray-water, identify areas of current or potential soil loss or reduced soil fertility and partner with other agencies to reduce and control these problems, educate producers on the important interactions of soil and irrigation, provide information on soil nutrient deficiencies and cost effective soil quality and fertility improvements, continue demonstration projects - salinity, soil types, non-traditional soil fertility amendments, fertilizer formulation efficacy, organic matter use and management.

2. Brief description of the target audience

The target audience includes the general public, users of various environments (agricultural producers, extractive industry representatives, environmentalists, green industry professionals, etc.), small acreage owners, private forest owners, extension agriculture and horticulture agents, federal and state water and soil management agencies, and other academics and resource managers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	13578	539587	6210	246784

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

Patent Applications Submitted

Year: 2018

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	97	97

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of clientele who gain knowledge about improved human, plant, and animal management systems that relate to climate change and/or natural resource use.
2	Number of clientele who implement improved human, plant, and animal management systems as related to climate change and/or natural resource use.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	16994

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Utah has experienced moderate to extreme drought trends over the past 12 years. About 53% Utah?s potable water is used to irrigate landscapes. Coupled with a positive population growth rate and increased urbanization, water conservation is major concern for the state. Therefore, there is a need to equip residents with the knowledge and skills needed reduce their landscape water consumption and conserve dwindling water resources.

What has been done
Residents were given soil moisture meters, had access to online educational resources, benefited from individual residential support through the Master Gardener program, and attended the annual Water Fair in Cedar City.

Results
The soil moisture meters provided to residents encouraged positive change in landscape irrigation behavior. Participants were able to measure soil moisture and decide when to irrigate and how much water was required in their landscape. This effectively reduced irrigation cycles; 72% of public participants reduced their landscape irrigation after using the soil moisture meter.

4. Associated Knowledge Areas

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

123	Management and Sustainability of Forest Resources
132	Weather and Climate
135	Aquatic and Terrestrial Wildlife
205	Plant Management Systems
213	Weeds Affecting Plants
307	Animal Management Systems
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	9018

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Utah is recognized for its natural recreational resources. However, these resources compete for land with agriculture and livestock industries. Since Utah?s vibrant tourism industry depends on access to recreational resources, there is a need to preserve Utah?s natural resources for recreation, biodiversity, ecosystem health, and wildlife productivity. However, Utah?s biodiversity is being threatened and wildlife populations are in decline. Research and information are needed to guide natural resource management decisions at the governmental and residential level.

What has been done
The Conservation Tree Program seeks to address issues related to livestock protection, wildlife habitat restoration, energy conservation, and wind control.

Results
Conservation trees and shrubs planted are projected to provide a value of $275.00 a year in benefits. Assuming a 70% survival rate, the value of the 3,000 trees and shrubs sold and planted this year is $825,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
132	Weather and Climate
205	Plant Management Systems
213	Weeds Affecting Plants
307	Animal Management Systems
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The soil moisture meters provided to residents encouraged positive change in landscape irrigation behavior. Participants were able to measure soil moisture and decide when to irrigate and how much water was required in their landscape. This effectively reduced irrigation cycles; 72% of public participants reduced their landscape irrigation after using the soil moisture meter.
Conservation trees and shrubs planted are projected to provide a value of $275.00 a year in benefits. Assuming a 70% survival rate, the value of the 3,000 trees and shrubs sold and planted this year is $825,000.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Sustainable Energy

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
402	Engineering Systems and Equipment	67%		0%	
403	Waste Disposal, Recycling, and Reuse	33%		0%	
502	New and Improved Food Products	0%		50%	
511	New and Improved Non-Food Products and Processes	0%		50%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	0.5	0.0
Actual Paid	0.4	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
7177	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
7177	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

1. Conduct research into alternative biofuels and methods of production that are well-suited for the Intermountain West.
2. Publish in peer-reviewed journals and other professional outlets.
3. Take the research that is done and adapt that research so useful practical strategies might be followed in producer biofuels to the extent that it can be shown to be beneficial in terms of benefits and costs.

2. Brief description of the target audience

For experiment station faculty their target audiences are primarily directed towards extension specialists, county agents, and other scientists; the extension specialists' audiences include peers, county agents, federal and state organizations, producer groups, state and local government, and the general public. County agents work cooperatively with federal, state, and local governments, citizen groups, and the public to address sustainable energy issues in their areas.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	201	270	36	48

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of clientele gaining sustainable energy knowledge
2	Number of clientele who implement sustainable energy practices

Outcome #1

1. Outcome Measures

Number of clientele gaining sustainable energy knowledge

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	41

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse

Outcome #2

1. Outcome Measures

Number of clientele who implement sustainable energy practices

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	41

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse

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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Evaluation results indicated 41 participants gained knowledge on sustainable energy, and 41 implemented sustainable energy practices.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Childhood Obesity, Nutrition and Community

☑ 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
305	Animal Physiological Processes	0%		3%	
501	New and Improved Food Processing Technologies	0%		6%	
604	Marketing and Distribution Practices	0%		3%	
607	Consumer Economics	0%		3%	
608	Community Resource Planning and Development	5%		8%	
702	Requirements and Function of Nutrients and Other Food Components	10%		22%	
703	Nutrition Education and Behavior	0%		6%	
723	Hazards to Human Health and Safety	0%		3%	
724	Healthy Lifestyle	4%		6%	
801	Individual and Family Resource Management	16%		3%	
802	Human Development and Family Well-Being	8%		5%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	3%		11%	
805	Community Institutions and Social Services	0%		5%	
806	Youth Development	54%		11%	
903	Communication, Education, and Information Delivery	0%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	50.0	0.0	7.8	0.0

Actual Paid	45.3	0.0	6.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
878510	0	331856	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
878510	0	331856	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1239486	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

1. Conduct research with respect to human nutrition, family finances, bankruptcy, and community development.

2. Publish studies and make presentations related to individuals, family finances, and community well-being.

3. Conduct workshops and meetings, deliver activities, develop new curricula, write newsletters and news releases and post Internet fact sheets.

4. Provide training in a variety of mediums-face-to-face, satellite, group discussions, demonstrations, conferences and workshops, via DVDs, CDs, fact sheets, newsletters, and other media.

5. Include the following materials or media sources in training sessions: Take Charge of Your Money, Power Pay and Power Saves, Utah Saves Education and Outreach, Individual Development Account, First Time Homebuyer Assistance, Financial Education for Bankruptcy Filers (USU is certified by the Department of Justice to offer debtor education classes), Living Well on Less, Money Sense for Your Children, and Earned Income Credit assistance.

6. Utilize different teaching methods of The Utah Food Stamp Nutrition Education including individual, group classes, DVD video series, and an on-line course. FSNE Nutrition Education Assistants will provide other nutrition education opportunities to FSNE participants

7. Use the "Give Your Body the Best" curriculum developed in 2005 by USU to teach individuals or groups of low income persons regarding chronic diseases; on food allergies, intolerance, and poisoning; and lessons on getting to know foods and enjoy them.

8. Increase the capacity among other extension personnel to participate in or lead community self-assessments (SWOT analyses, asset mapping, search conferencing, surveys, etc.) that lay the groundwork for subsequent project activities.

9. Conduct research experiments and/or develop theories that can be used to explain (a) causes for public land conflicts and potential solutions, (b) solutions to the urban expansion into rural areas and open space, and (c) conditions for continued rural community economic viability.

10. Publish studies and make presentations related to these areas of concern.

11. Conduct workshops and meetings to educate local, state, and regional stakeholders concerning these issues.

12. Deliver educational and informational services through various media.

13. Develop educational resources related to rural economic viability for community leaders and

other stakeholders

14. Provide for local training in principles developed that are related to this area of study.

15. Conduct design activities (for a park, a Main Street revitalization, etc.) that will typically yield a design of variable specificity (some might be conceptual drawings, others might be more extensive).

16. Provide consultations regarding land use planning policies and their implications on growth.

2. Brief description of the target audience

The target group is the general population of Utah (including youth), with a special emphasis on Native Americans, Latinos, African Americans, Asians/Pacific Islanders, and low income families with children at or below poverty levels, food stamp program eligible individuals, and individuals facing bankruptcy. A subgroup of the audience targets is pregnant teens and teen mothers.

Elected officials, appointed officials, general population (including youth), and at-large community opinion leaders and influential people are targeted for community development.

3. How was eXtension used?

P. Hill developed the curriculum used by eXtension for their Impact Collaborative Innovation workshops. The workshops foster creativity, experimentation, and idea implementation. It helps individuals work through the stages of idea creation, application, and implementation of projects and programs.

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	109877	1950365	236652	4200676

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	7	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of clientele who gain knowledge about nutrition education and behavior.
2	Number of clientele who implement practices of nutrition education and behavior.
3	Number of clientele who gain knowledge about individual and family resource management.
4	Number of clientele who implement individual and family resource management.

Outcome #1

1. Outcome Measures

Number of clientele who gain knowledge about nutrition education and behavior.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	36173

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sanpete County has a food insecurity rate of 15.1%, one of highest in Utah. This suggests about 4,250 individuals in the county experience hunger on a regular basis. Therefore, food insecurity is a concern and a reality among Sanpete County residents. Food insecure individuals have limited access to adequate, well-balanced meals due to insufficient economic resources. Due to a higher than average poverty rate, 50% or more of students in all eight elementary schools of the county are eligible for free or reduced lunches.

What has been done
Food $ense activities were delivered to 1,515 participants through a partnership with the Six County Area Association of Governments to serve low-income youth populations. Further, the Kid Pack program provided nutritional meals to children over the weekends.

Results
Roughly 1,477 youth and 38 adults participated in nutrition education activities focusing on MyPlate concepts in 2018. Youth and adults gained nutrition knowledge and skills which allowed them to make healthy food choices. Families throughout Sanpete County received nutritious meals for their children through the Kid Pack program. The Kid Pack Program led to a decrease in household grocery bills for low-income families.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
702	Requirements and Function of Nutrients and Other Food Components

703	Nutrition Education and Behavior
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
806	Youth Development

Outcome #2

1. Outcome Measures

Number of clientele who implement practices of nutrition education and behavior.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	31417

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Low income families are at a higher risk for chronic diseases such as obesity and diabetes compared to others. These families are often unable to purchase healthy meals due to budget constraints. As a result, there is a need for low-income families to learn basic nutrition and cooking skills. This will provide them with the knowledge and skills needed to prepare nutritional meals for their families on a limited budget.

What has been done
Utah Food Stamp Nutrition Education Program (FSNE or Food $ense Nutrition Education F$NE) is contracted through Utah State University Extension. Iron County provides Food Stamp Nutrition Education to low income families or individuals.

Results
Food Bank recipients who participated in the Commodities classes learned about new recipes using common grocery items and were able to demonstrate their cooking skills in class. About 50% of the participants stated they tried and adopted the new healthy and affordable recipes at home.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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
806	Youth Development

Outcome #3

1. Outcome Measures

Number of clientele who gain knowledge about individual and family resource management.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	13623

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Weber County has one of the highest personal bankruptcy rates in Utah. It also has the highest per capita rate of payday lenders of any other community in the state. As consumer debt across the country continues to rise, there is a need for sound financial management education targeted to families.

What has been done
USU Extension delivered several money management programs to residents, including Smart Money Moves! and Individual Development Accounts (IDA) classes.

Results

Evaluation results indicated IDA participants adopted most of the recommended practices; there were 63 new IDA accounts. In addition, 63 households benefited from new home buyer education and certification.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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
806	Youth Development

Outcome #4

1. Outcome Measures

Number of clientele who implement individual and family resource management.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	1271

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Finding affordable housing in the urban areas of Utah is difficult. Utah ranks high in mortgage fraud and foreclosure. Homeowners have been attracted to new nontraditional mortgage products, such as those featuring interest-only or negatively amortizing payments, and adjustable rate mortgages (ARMs). Nontraditional mortgage loans carry a higher risk of default. However, residents are unfamiliar with their options when making these types of financial decisions. There is a need for housing education to help residents make wise financial decisions when choosing a mortgage, making mortgage payments, handling financial emergencies, and avoiding foreclosure.

What has been done
Affordable housing education has been provided to potential homeowners and renters through face-to-face and online certification courses.

Results
Fifteen participants attending a total of three face-to-face courses in Salt Lake County received certification to meet HUD loan requirements. Additionally, 546 participants from Utah and 31 participants from other states took the Online Home Buyer Education Course with 506 receiving certifications.

4. Associated Knowledge Areas

KA Code	Knowledge Area
608	Community Resource Planning and Development
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
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
806	Youth Development

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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Roughly 1,477 youth and 38 adults participated in nutrition education activities focusing on MyPlate concepts in 2018. Youth and adults gained nutrition knowledge and skills which allowed them to make healthy food choices. Families throughout Sanpete County received nutritious meals for their children through the Kid Pack program. The Kid Pack Program led

to a decrease in household grocery bills for low-income families.
Food Bank recipients who participated in the Commodities classes learned about new recipes using common grocery items and were able to demonstrate their cooking skills in class. About 50% of the participants stated they tried and adopted the new healthy and affordable recipes at home.
Evaluation results indicated IDA participants adopted most of the recommended practices; there were 63 new IDA accounts. In addition, 63 households benefited from new home buyer education and certification.
Fifteen participants attending a total of three face-to-face courses in Salt Lake County received certification to meet HUD loan requirements. Additionally, 546 participants from Utah and 31 participants from other states took the Online Home Buyer Education Course with 506 receiving certifications.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
311	Animal Diseases	0%		13%	
501	New and Improved Food Processing Technologies	0%		37%	
502	New and Improved Food Products	0%		13%	
504	Home and Commercial Food Service	60%		0%	
602	Business Management, Finance, and Taxation	0%		12%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	40%		25%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2018	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	3.5	0.0
Actual Paid	4.4	0.0	3.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
84767	0	188418	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
84767	0	188418	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	693071	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

1. Conduct experiments and develop theories that can be used to develop a safer food supply from production, through processing, and to the final consumer.
2. Conduct experiments and develop theories that can be used to develop new food products or improve existing food products.
3. Publish studies and make presentations related to these two areas of concern.
4. Extend research to Utah residents, family consumer scientist agents, small and medium sized food processors, restaurant food safety managers to provide educational training and in-depth information on: safe food handling practices, safe food preservation and storage practices, certification to food safety managers, safe food handling practices for processors, and 4-H nutrition and health safety curricula and programs.

2. Brief description of the target audience

The target audience will include food processors, agricultural producers, general consumers (both within and without Utah), family consumer science agents, at risk groups and their families, and other scientists.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2018	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9243	37954	9158	37604

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

Patent Applications Submitted

Year:	2018
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2018	Extension	Research	Total
Actual	0	13	13

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of clientele who gain knowledge about home and commercial food service.
2	Number of clientele who implement home and commercial food service practices.

Outcome #1

1. Outcome Measures

Number of clientele who gain knowledge about home and commercial food service.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	4982

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Food preservation and storage are commonly practiced in many homes. Unfortunately, many residents are using outdated and unsafe canning and preservation recipes. Educational programming is needed to prevent food poisoning due to unsafe recipes and practices.

What has been done
USU Extension provided a variety of services to ensuring food safety in home preservation and storage. These include testing caning equipment, providing educational programs, and offering online resources related to home canning and food storage.

Results
Two presentations on cooking with food storage ingredients was attended by 53 people. The classes provided cooking best practices recommendations for common food storage ingredients.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Number of clientele who implement home and commercial food service practices.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2018	2327

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to public health and food safety experts, millions of illnesses in the US can be traced to foodborne bacteria. There is a need to provide education on food illnesses to resident. Programs are needed on proper food safety techniques to decrease the risk of foodborne illness.

What has been done
As part of food safety educational programming, equipment to ensure food is properly cooked was provided to food banks in Utah.

Results
Meat thermometers with food safety information were given out to 140 Thanksgiving baskets through the food bank. Follow up evaluation indicated a majority of those who received the meat thermometer used them and properly cooked their turkey.

4. Associated Knowledge Areas

KA Code	Knowledge Area
311	Animal Diseases
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
504	Home and Commercial Food Service
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Two presentations on cooking with food storage ingredients was attended by 53 people. The classes provided cooking best practices recommendations for common food storage ingredients.
Meat thermometers with food safety information were given out to 140 Thanksgiving baskets through the food bank. Follow up evaluation indicated a majority of those who received the meat thermometer used them and properly cooked their turkey.

Key Items of Evaluation

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.