2015 Utah State University Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Global Food Security and Hunger

Integrated Pest Management

Corey Ransom has been working on enabling pesticide registrations for specialty crops and minor uses. Over 49 product requests were processed and those with potential application to Utah were forwarded to pest management specialists so they could add a request for that product if it was needed in Utah. Through the IR-4 program there have been 175 food use pesticide tolerance requests from Utah with 33 products having current registrations, and the other request at various stages of consideration. Claudia Nischwitz is investigating managing Iris Yellow Spot Virus (IYSV) in onion by targeting weedy virus reservoirs and reproductive hosts for onion thrips, which are the vector for IYSV, including common mallow, prickly lettuce, bindweed and volunteer onions. Weed control was greatly improved with about 80% of observed onion fields having good to excellent weed control within the field and the farmscape.

Horticulture

Brent Black has been working on expanding opportunities for fruit production in Utah. All three plantings (2010--2012) were maintained through 2015. A mechanical harvester was used to harvest the 2010 and 2012 plantings. Yields in several single-leader treatments are meeting commercial thresholds. Work was completed in 2015 to evaluate tree response to renewal pruning cuts and to mechanical hedging. Pruning cuts were made in the 2010 high-density cherry block in March, 2015. Machine and hand harvests from each plot were weighed and recorded and will be compared for yield.

Success Story: Juab County Extension conducts a public weed awareness program. This year, 355 individuals increased their knowledge in the areas of weed control, pesticide safety and use. This represents nearly 15% of all the households in the county. During this year's program, $15,930.00 was saved by program participants and 177 acres of weeds have been sprayed.

Crops

Hole released curlew wheat in 2010. Curlew is a hard red winter wheat with excellent resistance to dwarf bunt and good yield and baking qualities when grown under dryland conditions. PVP#201100464 was issued in 2013 for Lucin CL wheat, a hard red winter wheat incorporating a single licensed gene for tolerance to the Imidazolinone class of herbicides. It has yield and quality advantages over previous dryland cultivars. PVP#201200470 was issued in 2014 for Greenville wheat. Greenville is a hard red winter wheat that performs well under irrigated high nutrient management systems and outperforms other short statured cultivars, while incorporating good milling and baking characteristics and resistance to stripe rust. Yield increases of adopted new released cultivars from this project have generated approximately 7.5 million in additional income directly to producers in the state each year. Another of their projects is to breed and test improved varieties of barley, spring wheat and oats. Crosses and selections made over the past five years resulted in one release candidate and one potential release.

Creech found that (1) GR alfalfa can be effectively terminated with herbicides and tillage, alone or in combination, (2) herbicides were more effective than tillage at suppressing alfalfa growth, reducing alfalfa stem count and biomass by at least 95%, and (3) timing of herbicide application (fall, spring, or in-crop) had no effect on alfalfa control. The two key findings include: (1) silage corn can be grown after alfalfa in Utah with or without tillage (no-till or strip-till) and (2) N fertilizer does not appear to be necessary for first year corn after alfalfa which would significantly reduce fertilizer N costs for growers who rotate corn with

alfalfa.

Success Story: At a biannual Utah Alfalfa symposium 293 farmers, ranchers, and individuals interested in alfalfa learned about all aspects of alfalfa, including: GMO testing, insects, hands on herbicide injury identification demonstration, pest management, marketing, etc. Participants reported a significant gain in knowledge; that they intend to use it; that they believe it will translate into increased profitability; and that it will impact a huge number of acres in Utah and surrounding states.

Drost has been investigating crop rotations and cover crop strategies for vegetable crops at the USU Kaysville Horticulture Research Farm, Kaysville, Utah. Broccoli biomass was suppressed more when grown after kale and wheat than after hairy vetch, respectively. Green bean yields were comparable when grown after hairy vetch, kale, or wheat demonstrating beans ability to fix sufficient nitrogen from rhizobia nodulating the plants roots. Vegetable crops were responsive to plant produced N from hairy vetch as growth followed crop productivity trends. High nitrogen CCs stimulate weed growth. Millet and organic growers were better able to distinguish differences between winter and summer CCs and how to use them.

Dairy

Although there were some challenges with BFT establishment, MacAdam improved organic milk production through the use of the condensed tannin-containing forage legume birdsfoot trefoil an average of 18.5% more than on well-established mixed grass pastures. They found that nitrogen use efficiency was improved. Cheddar cheeses made from the milk of cows grazing BFT or grass pastures were compared with cheddar made from the milk of cows fed a TMR in confinement and an expert sensory panel detected some less-desirable taste characteristics, but work is continuing on both. Eun worked on improving feed efficiency in dairy and beef cattle to enhance productive and environmental performance. A beef steer growth trial was conducted to determine effects of feeding brown-midrib corn silage (BMR)-based total mixed ration (TMR) compared with conventional corn silage-based TMR (CCST) on growth performance, ruminal fermentation, and economic parameters. Steers fed the BMRT tended to have greater average daily gain (1.54 vs. 1.42 kg/d) and gain-to-feed ratio (0.165 vs. 0.146) compared with those fed the CCST. Results of this study indicate that feeding the BMRT to growing beef steers enhanced ruminal fermentation and beneficially shifted VFA profiles, which contributed to improved growth and economic performance of steers. Feeding BMRT compared with CCST increased returns by 36%.

Success Story: The USU Extension Dairy Specialist and his team have done three statewide surveillance projects of bulk tank milk from most dairy farms in Utah, testing for several important diseases (mycoplasma, Johne's disease, and/or BVD.) For the first time during 2015, due to the follow up and outreach with farms testing positive for mycoplasma, Johne's disease, and/or BVD, Utah became one of a few states to have the state mean Somatic Cell Count in all bulk tank milk less than 200,000/ml. This reflects continued improvement in milk quality.

Risk

Kim has partially his achieved first research goal of the determining the effects of crop insurance on farmers' production behavior focusing on prevented plantings. This study examines the existence of moral hazard in choice between prevented planting (PP) and late planting (LP) in crop insurance. Crop insurance may alter farmers' decision on making selection of PP and LP. As evidenced by the recent large shares of PP payments, crop insurance may increase the likelihood of PP claims even though the farmer can choose LP, which is considered a moral hazard.

Beef

A group of scientists are studying the economics of livestock production using a unique beef production system in which cattle and sheep are fed and finished on a diversity of bioactive (e.g., tannins, saponins) containing legumes to optimize productivity per land unit area while reducing environmental impacts. Preliminary findings show that a diversity of legumes enhances forage intake and in vivo digestibility of the forages consumed while reducing blood urea nitrogen relative to monocultures.

Success Story: Sixty-five attendees at a Cowman's Reproduction Workshop (CRW) manage 6,623 head of beef cattle. Ninety-four percent of the CRW attendees indicated the overall quality of the workshop to be excellent or higher. Most importantly, 65% of the CRW attendees from previous years have implemented reproductive management changes in their herds and over 58% have seen improvements in herd reproduction.

Success Story: A local rancher contacted Extension indicating that over the past four years he had a steady decline in his calf crop from approximately 90% to around 45-50%. He attributed the decline to a decision to stop vaccinating in the fall for Vibrio/Lepto. He requested help from the Extension service to determine the cause of decline and to offer advice on vaccinations. Kerry Rood, USU Extension Veterinarian, and an Extension agent traveled out on the AZ Strip to pull blood samples from the rancher's cows. The blood work came back with titers for vibrio species. This indicated that the rancher needed to vaccinate for vibrio. Dr. Kerry Rood recommended a vaccine with proper boosters and administration. Last fall, the rancher's pregnancy rate was around 90%, a significant improvement from the previous year.

Other Projects

Bosworth with his research on private labels, national brands, and local designations directly addresses the degree to which local designations can influence retail food sales outcomes. The sensory analysis and stated preference survey results suggest that local food designations have real value in terms of willingness-to-pay by consumers for ice cream if products are of high quality.

Sustainable Energy

Kim's results show that biomass co-firing is not economically feasible in Utah, but could be feasible when co-benefits (sales of greenhouse gas emission credits and health benefit from reducing harmful air pollutants) are considered. Benefit-cost ratio is critically dependent on biomass and carbon credit prices. It generates the additional $7 million in gross revenue for the Utah farms assuming $40 per ton of crop residue (biomass) price. Total economic impact in Utah is estimated to be $13 million, 210 new jobs and $5 million in value added. A Utah Computable General Equilibrium (CGE) model was constructed for the biomass development policy simulation. Preliminary results show that biomass co-firing may increase gross state product and shift land use to corn from hay. However, the co-firing mandate may increase the price of electricity for residents in Utah without improving biomass co-firing technology.

Natural Resources

Jenkins determined that Great Basin bristlecone pine volatiles are not attractive to mountain pine beetle when compared to limber pine volatiles. This work changes the commonly held view that Great Basin bristlecone pine is a host of mountain pine beetle. This finding has fundamental importance in fuels alterations when compared to other high elevation pine systems in the West.

Chu and Adler show in their study systems, interspecific interactions are weak and single species models perform adequately. Kleinhesselink and Adler's paper supports Adler's previous findings that large niche differences should decrease the indirect effects of climate change, but provides more information about the different kinds of ways that indirect effects can operate in nature. They found the demographic model to be more sensitive at detecting climate influences than the population-level model.

Work by Endter-Wada investigating water policy preferences of Utahns surveyed as part of the iUTAH project found strong public support for water policies, programs and management strategies that promote urban water conservation, agricultural preservation, and environmental protection. This objective was extended beyond the Intermountain West through comparing water challenges that megacities of the world confront.

Success Story: Extension's Salinity Program in the Price/San Rafael region reduced salt loading in the Colorado River by 153,000 tons each year. In addition, participating farmers consistently report yield increases when they switch from furrow to sprinkler irrigation. Much of this increase is probably due to better irrigation timing, and to a lengthened irrigation season. Furrow systems wasted so much water that farmers could not irrigate as often as they needed to, and water supplies often ran out earlier than they might have. Most farmers report a 40 to 50% increase in alfalfa yields after switching to sprinklers. This translates into an additional 1.5 to 2.5 tons of hay per acre, or an extra $250 to $400 per acre.

SLIDE Rules (incorporates ASABE S623 standard) as developed by Kjelgren was approved by the American National Standards Institute. The ASABE S623 standard is now a national standard. The ASABE S623 standard is in part based on Kelgren's research on water use in trees and the basis for SLIDE Rules that address the complete picture of landscape water management. WaterMAPS developed by Kelgren was used to mine water billing data to assess end user capacity to conserve water. WBWCD showed that reports to metered end users based on WaterMAPS reduced water use. Utah's 200,000 acre-

ft. from the Bear River based on the Bear River Compact is expected to supply much of Utah's future urban water demand. The Bear River reconstructions will help guide planners in assessing how best to develop future water sources on the Bear.

Edwards analyzed individual agricultural parcel data in Kansas after the completion of a large data set linking land sales, crop choice, and aquifer characteristics. Preliminary analysis indicates that crop rotation is affected by aquifer access and drought. Land value through time is shown to be related to water access, and more importantly, to differences in the physical characteristics of the aquifer, for instance saturated thickness.

Boettinger's team developed a quantitative methodology based on the conceptual model of soil formation using digital, spatially explicit data to predict the distribution of soils on the landscape. The work resulted in initial and refined soil maps on more than 562 square miles in Utah, Wyoming, and New Mexico. Boettinger and colleagues explored the potential for digital soil mapping to find solution for global issues such as food security and land degradation and have characterized and developed models predicting rare plant habitat in the Uinta Basin of eastern UT.

Preliminary evidence from Schupp suggests the threatened S. wetlandicus is not associated with any particular undisturbed plant community in the study suggests S. wetlandicus is not a habitat specialist which implies that its populations perhaps can be augmented by establishment in presently unoccupied areas to mitigate for damage to existing populations during energy development. However, evidence-to-date suggests that reclamation of well pads, and likely roads and pipelines as well, has been inadequate to create suitable habitat.

Significant findings of Cardon's research were the contrast of the effects of traditional (mineral fertilizer) and non-traditional (bio-stimulant enriched fertilizer solutions) management technologies, demonstrating no advantage to the higher-cost non-traditional technologies. He determined the importance of annual fertilization in terms of productivity over the life of the orchard, regardless of statistically insignificant annual effects of fertilizer application; the validation of university recommendation limits of tissue nutrient content previously adopted from other fruit growing regions of the country, for Utah-specific soil and climatic conditions; and the effect of fruit tree nutrient status on cold and freeze tolerance.

Brunson's group found that simply creating a weed management zone did not lead to increased awareness of weed issues or beliefs about the need for or effectiveness of practices to reduce weed invasions in northern Utah and southern Idaho. Results suggest that managers' decisions are largely driven by top-down factors (policy, budget, time allowed to plan restoration activities, as well as concern that the public will not support new initiatives). Conversely, the public believes managers should have more freedom to operate by local knowledge and they tend to support new initiatives.

Schupp examined the spatial and temporal pattern of tree seedling recruitment in four woodland plots spanning a 350 m elevational gradient in the Grand Staircase-Escalante National Monument (GSENM). During extremely dry periods when trees are stressed there can be elevated mortality of adult pinyon trees due to beetle infestation. Otherwise adult mortality is extremely rare. Recruitment depends on the coincidence of a good seed crop (which is an irregular occurrence) with a wet winter/spring. Because of the slow dynamics of these woodlands reliable data require long-term studies. Schupp also assessed the effects of vegetation management treatments (e.g. burning, thinning) and sowing treatments (e.g. nitrogen immobilization, pre-emergent herbicide application, activated carbon application) on the emergence and establishment of desirable perennial grass species seeded into degraded rangelands and demonstrated despite a low density and diversity of desirable perennials above ground there is a very diverse seed bank that might help improve the health of the sagebrush community; that there are management options (nutrient immobilization, pre-emergent herbicide application) that severely impact cheatgrass emergence, growth, and seed production and open a narrow but critical window for perennial establishment. These results help with restoration and management decisions on nearly 100,000,000 acres of cheatgrass-invaded rangelands in the western US. In particular, our work has led to increased work on the potential use of pre-emergent herbicides and multi-year as a restoration tool. Schupp demonstrated pollinators must be protected and dust must be managed to minimize impacts of resource development.

Villalba, with his team of graduate students and post-docs, found that high-energy supplements

enhance use of medusahead by sheep, particularly for thatch, while enhancing body weight gains. They conclude that the biggest constraints for medusahead control, in ranked order are (1) Economic, namely the insufficient and highly variable funding for medusahead research or outreach coordination; (2) technical plus economic, namely the need to discover a technically- and cost-effective method to reliably eliminate medusahead; (3) the need to better-train weed coordinators in both the technical and human-dimensions aspects of their jobs and improve the transition from one coordinator to the next; and (4) social, namely the socio-economic heterogeneity of the local landowning-population that undermines efforts to rally a critical mass of people to help solve common problems. If a reliable and inexpensive means to kill medusahead is discovered, the problem in this study area would gradually solve itself. At present there are no low-risk tools for medusahead control that can be reliably extended.

Brunson completed a study of factors that influence adoption of homeowners' adoption of wildfire risk-reduction practices at the Wildland-Urban Interface. Results show that cultural factors, local environmental and social contexts, and personal experience with wildfire all interact to influence decisions whether and how to mitigate wildfire risk. Results from another survey suggest that managers' decisions are largely driven by top-down factors (policy, budget, time allowed to plan restoration activities, as well as concern that the public will not support new initiatives, whereas the public believes managers should have more freedom to operate by local knowledge and they tend to support new initiatives.

Kettenring, Cranney, and Rohal found that all fall herbicide application treatments were effective at greatly reducing phragmites cover at the Great Sal Lake (GSL). Litter cover in the large stand study and litter depth in the small patch study has declined significantly in 2015 vs. previous years. Native plant recovery is improving in the small patch study, but is still scant in the large study.

Grossl has attempted to establish a study that assessed different carbon amendments, along with a barley cover crop, for reclamation success. It appears that wood chips and biochar were able to hold more soil moisture than non-treated controls, and the barley cover crop was initially able to limit weed invasion. However, it also appears that cheat grass invasion was greater on woodchip plots-perhaps cheatgrass was able to capitalize on the greater moisture content provided by the wood chips. Grossl also evaluated Se losses via volatilization from the wetland and wetland plants, and began to develop risk assessment models to predict the potential hazards of Se to the food web within the wetland. About 25 % of the selenium entering the wetlands exited the wetlands at the outlet. Selenium retained in the Pariette Wetlands may be problematic to wildlife feeding in the area depending on the mechanism of removal of Se from the water.

Jacobson and graduate students completed experiments and data analysis comparing the sorption and desorption of selenate and selenite on calcareous soils and carbonate minerals, with Se sorption to carbonates is much weaker than to oxides. Their analysis showed that the mitigation efforts undertaken by the state and federal agencies to reduce the Se hazard in the Pariette Wetlands have been largely successful. In 2015, Jones and a team of undergraduate field assistants collected water, sediment, and vegetation samples, in at least three sites in each of 5 ponds in the Ouray Wildlife refuge. The samples were analyzed for Se as a contaminant oxyanion, which exceeded the US EPA's TMDLs, and salt indicators (EC and TDS) in the late 1980s. The complex has since then been drained, and berms constructed to redirect water flow and seepage. They concluded that the Se is introduced primarily through underground seep or springs and Se hazard mitigation measures undertaken in the Ouray Wildlife Refuge since the late 1980s have been largely unsuccessful.

Kopp found significant differences in total water application were observed relative to each water controller, with the control tending to have higher values than the climate-based controllers. Differences in stomatal conductance of plant materials were also observed with plants in the Weathermatic® plots having the highest values on most days and plants in the Rainbird® plots having the lowest values. All of the climate-based controllers tested saved water.

Jakus' project reports on the transfer of federal land to state ownership were released in November 2014. The first focuses on the effect of public land ownership and management on economic growth at the county level. The second manuscript addresses the fiscal implications of the state of Utah managing an additional 31 million acres of public land and find commodity prices, particularly for oil and natural gas, need to be high (relative to historical values) in order for the state to generate sufficient revenue to cover

its land management costs. Total annual economic value of maintaining current nutrient load in waters throughout the state of Utah are estimated to be between $3.13 and $13.61 per household for those households who engage in water-based recreation, and between $2.19 and $7.05 per household for those who do not recreate on Utah waters. For water quality improvements, "user" households were willing to pay between $8.11 and $31.97 per household annually, whereas non-user households were not willing to pay any more than to maintain current water quality.

Monz continues to advance field and analysis techniques incorporating the latest in GPS, GIS and computer image analysis. This has been operationalized in Rocky Mountain National Park where they have employed GPS technology in the determination of visitor use patterns and behaviors on Longs Peak. An important outcome of this work will be the development of an overall "visitor capacity" on Longs Peak and a more targeted management strategy that addresses visitor needs, crowding issues and safety concerns.

Belmont's group completed their analysis to evaluate the probability of debris flows occurring in sub watersheds throughout the Twitchell Canyon study area and observed good agreement between model results and their observations of channels that have been impacted by post-wildfire erosion. These results will help constrain the extent and frequency of past wildfires in and around the Twitchell study area. Results indicate 10-15 past wildfires in the area over the past 8,100 years.

Bosworth, with Co-PI's, shows that, at current prices, natural gas vehicles are not economically competitive with gasoline vehicles for the majority of consumers. Their estimate is that greenhouse gas emissions will be reduced by 8.7% in 2013 in Washington State. In the same year, fuel tax revenue loss is estimated at $106 million.

Cardon and others have shown after 10 site years over three growing seasons and in six different counties across Utah that greater nitrogen credit can be given to a previous alfalfa crop to corn in the first year of rotation. This result is significant in that it is possible to reduce the N requirement for first year corn after alfalfa between 100 and 200 units of N per acre (based on typical grower practice and USU recommendation levels) without yield reduction. This is projected to potentially save Utah corn growers up to $6 million annually. This work indicates the long time adopted sufficiency levels appear to function well in Utah orchards, but that there is much room for improvement in increasing nutrient levels in Utah fruit trees primarily for potassium, phosphorus and iron.

Ransom has data from the fifth year of trials established to evaluate management of downy brome and Russian knapweed at Dinosaur National Monument. Trials illustrate the importance of continued management in controlling invasive annual and perennial plants and for recovery of infested sites. Seeds were collected from kochia populations across the state of Utah and screened for resistance to ALS and growth regulator herbicides. Approximately 35% of the populations sampled had high to very high levels of resistance to chlorsulfuron. Several herbicides were identified as effective for controlling rush skeletonweed, a new invasive species in Utah. Fall application timing was more effective than those made mid-summer. Greenhouse trials evaluated herbicide response of forage kochia, an improved plants species being used in rangeland restoration efforts. Results were inconclusive and additional research is needed. An effort to identify new infestations of medusahead in Morgan County utilized historic imagery from google Earth to identify potential infestations, followed by a visit to potential sites by ground crews. Approximately 40% of the potential sites had medusahead.

Miller collected soil and leachate samples under plots containing Tall Fescue+N fertilizer (TF+N); Tall Fescue with no fertilizer (TFNF); Tall Fescue+Alfalfa (TFALF); and Tall Fescue+Birdsfoot Trefoil (TFBFT). Preliminary results indicate that the TF+N treatment results in higher available soil N and higher nitrate concentrations in the leachate. TF-N tended to have some of the lowest available soil nitrogen levels and nitrate concentrations in the leachate.

Climate Change

Johnson developed a cooperative project with USDA-ARS scientists to evaluate, select, and identify bluegrass germplasm with salt and drought tolerance. Selection of bluegrass genetic lines that have significant salt and drought tolerance compared to other Kentucky bluegrass varieties are evaluated at several locations in the West for more data. They also determined that improvement of Puccinellia lines with improved turfgrass tolerance was not reasonable with currently available germplasm.

Rob Gillies completed an operational forecast product releases are being provided through the Utah Climate Center website and media outlets. Updates of long-range forecasts that are now in operation include (i) 5-year Great Salt Lake level prediction that reflects Utah's drought situation; (ii) 30-day prediction for first fall freeze; (iii) 30-day forecast for climate extreme events such as heat waves and high rainfall. The forecast of first freeze this year was accurate (within one week).

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French and her team continued to gather information regarding the effects of anthropogenic landscape changes on populations of side-blotched lizards and in a longer- lived species of lizard, the rock iguana. They found reptiles respond different energetically and immunologically depending on stress state and energy balance. Also those animals that are infrequent feeders cope with energy stress differently than species that are frequent feeders. They found a surprising result that animals can decrease their standard metabolic rate in response to an immune challenge.

Li has demonstrated that about 50% of the new urban development occurred on agricultural land. The results revealed that the rural-urban gradient was correlated with the types of agricultural land conversion. Irrigated agricultural land contributed a larger portion than non-irrigated agricultural land. Work supporting this objective found that urban land use change occurs without explicit consideration of the long-term implications for water availability. Preliminary findings on water shows that urban landscape water use is generally twice, on average, of what is needed to maintain landscapes in healthy conditions.

Kjelgren's SLIDE Rules (which incorporates ASABE S623 standard) was approved by the American National Standards Institute and is now the official tool nationally. Weber Basin Water Conservancy District (WBWCD) is using WaterMAPs to track water use of 1000 secondary water users, as are several large water users including the Salt Lake City Public Utility and the City of Eagle Mountain. WBWCD used WaterMAPS to determine that the trial study of metered secondary water users showed that reports to end users based on WaterMAPS reduced consumption, and that most are using water below their allotment of three acre-feet. WBWCD is planning on renegotiating this excess allotment to recover about 600-800 acre-feet that can be used to meet future water needs. In Davis and Weber counties WB plans to meter about 30,000 end users relying on WaterMAPS to justify the expense in recovering about 25,000 acre-feet. Utah's 200,000 acre-ft from the Bear River based on the Bear River Compact is expected to supply much of Utah's future urban water demand, but no one knows how low the Bear River can go in dry years

In 2015, Jin conducted simulations with the Weather Research and Forecasting (WRF) model driven by the re-analysis data generated by National Centers for Environmental Prediction (NCEP) for the period of 2000-2009. Their results revealed the WRF model generates significant cold biases over high elevation regions in the western United States resulting from overestimated snow depth in the WRF model due to higher simulated precipitation. They will eventually fix these biases and produce improved simulations.

Jackson-Smith (and others) household survey project now has a solid dataset that documents how water needs of growing urban areas in the Intermountain West have been met over the last 30 years. Growth in population and expansion of urban water use has had little systematic impact on agricultural water use in the Intermountain West over the last 30 years. They found that suburban forms of development have higher rates of water use. The irrigation company member survey results demonstrate significant differences in the perceptions, behaviors, and concerns between irrigation shareholders who are engaged in farming versus those whose water use is residential.

A project by Gillies and his associates assessed two options: (1) developing a model using the observational Great Salt Lake (GSL) elevation record of 137 years to predict itself; (2) incorporating the recently reconstructed GSL elevation that utilized 576 years of tree-ring records into the predictive model. The GSL is particularly sensitive to low-frequency climate cycles. To overcome data limitations, they accessed newly obtained tree-ring data that can be used to extract climate signals for over 500 years, and

applied this data set to examine the variability of the GSL.

For the studies of dry and wet cycles, Hipps' attention was focused on California and the worst drought in the modern record. Collaboration with Dr. Wang revealed the cyclical droughts do not correlate with either El Nino or La Nina, rather to a strong ridge developing in precursor period in advance of an El Nino. It has been shown that fires in California are increasing in frequency and extreme wet and dry events in California are increasing in magnitude.

Peralta developed a new metric for quantifying groundwater resource resilience to climatic stresses, and applied it to groundwater management strategies developed for Cache Valley, Utah, and Idaho. Peralta also developed a new approach that can simultaneously develop optimal groundwater management strategies using multiple simulation models that can differ in geologic strata and discretization and a novel hierarchical optimization model that can reduce water use, increase water economic efficiency and maintain necessary agricultural production. He also developed a new nonlinear autoregressive model with exogenous inputs-type recurrent neural network model to forecast daily lake inflow for a 365-day horizon. This model provides more accurate long-term horizon flow pattern forecasting (20% lower RMSE) than linear auto-regressive models. Peralta developed a new efficient surrogate simulation method, employing aggregated convolution equation, which is ideal for integrated water use simulation-optimization modeling and can address linear and nonlinear aquifer systems, and for some situations can reduce computation time by 63-89% compared with previous response matrix methods. Peralta developed and applied a Utah valley simulation-optimization model for determining the maximum additional numbers of traditional home dwellers and apartment dwellers that can be sustained by groundwater, determined the robustness of such strategies under different climatic scenarios, and he developed a job-water use relations for agricultural, industrial, and service sectors and water sustainability constraints.

Brunson conducted a study of drought as a significant disturbance to ranching, and how ranchers in Utah, Wyoming, Colorado, Kansas and Oklahoma adapt their operations to recover from drought and reduce impacts of future droughts. They found that ranchers don't necessarily see drought as a specific challenge to plan for, but instead believe it one of many challenges addressed through constant effort to improve their operations. Land managers are skeptical of models of any sort, including climate models, but also the Ecological Site Descriptions that are supposed to guide restoration decisions.

Wang has produced the first reconstruction of April 1 snow water equivalent (SWE) using tree ring increment cores collected by the U.S. Forest Service Forest Inventory and Analysis Program (FIA) for the period of 1850-1989. The results showed a significant correlation with observed SWE, as well as statewide coherent variability on inter-annual to inter-decadal time scales.

Aubry re-established a capture-mark-recapture (CMR) study from 2013-2015 to detect potential changes in UGS phenology, demography, fitness, and population dynamics relative to 50 years ago in response to climate change. Results indicate that UGS are heavier today than 50 years ago, pointing towards a better phenological match between resource and consumer. These results are novel in that they do not seem to have reached a place of disruption between resource and consumer phenologies in this system, and climate warming seem to be beneficial to hibernator fitness.

Ramsey's team has have finalized the satellite-based evaluation of re-vegetation success on the Milford Flats fire of 2007 utilizing the most recent imagery collected in 2014 to assess changes in cheatgrass distribution and add to the growth trend of late-season perennial grasses. Their results show that post-fire cheatgrass distribution has not returned to pre-fire levels and that perennial late-season grasses continue to expand.

Rupp successfully added a ninebark accession from Strawberry Canyon, WY and a creeping Oregon grape from Hyde Park, UT to USU's collection for evaluation as potential water conserving landscape plants. In addition, he selected two riparian plants; a columnar western river birch and a redstem dogwood from the Raft River Mountains in northern Utah.

Miller examined the effect of soil compaction on nutrient cycling. Gaseous emissions from dairy manure under different treatment options indicate that approximately half of the ammonia is lost within the first 24 hours, and a majority is lost within 48 hours after application, indicating that immediate incorporation will help reduce ammonia loss, and preserve more nitrogen for plant growth. Preliminary

results from the urine and feces show a trend towards increased nitrogen in the feces when tannins are added to the diet.

Schupp located, mapped, permanently marked, and measured all new recruits to the four study plots in the Grand Staircase-Escalante National Monument (GSENM) and recorded mortality of pinyon and juniper that died during the project period. Results continue to support the idea that there are pulses of recruitment during favorable years occurring against a backdrop of more or less continuous mortality. Schupp demonstrated that despite a low density and diversity of desirable perennials above ground at Golden Spike National Historic Site (1) there is a very diverse seed bank that might help improve the health of the sagebrush community; (2) there are management options (nutrient immobilization, pre-emergent herbicide application) that severely impact cheatgrass emergence, growth, and seed production, (3) there is a narrow but critical window for perennial establishment, (4) that perennial emergence is negatively associated with cheatgrass density and biomass; and (5) that repeated seeding over multiple years improves the success of perennial establishment.

Mieregroet and her team continued to make progress towards determining pathways of soil organic carbon (SOC) stabilization in forest soils and assess the relative role of roots and foliage in creating differences in SOC persistence among forest covers. The positive relationship between SOC and nitrogen is robust and valid across soil depths, forest cover and aspen forest condition, lending support for its use as an indicator of soil/site quality.

Childhood Obesity, Nutrition, and Community

Childhood Obesity

Reither's research group's activities have focused primarily on exploration of the determinants of obesity and were the first to explore the cumulative effects of short sleep duration throughout adolescence on the subsequent risk of obesity. They conclude that future interventions and social policies should: (1) consider the context where obesity occurs most frequently; (2) enhance flexible resources such as knowledge and beneficial social connections; and (3) devote special attention to early life interventions that have shown tremendous promise in eradicating obesity disparities in the U.S. Their findings suggest that short sleep and obesity are independent risk factors, with sleep being more influential for psychosocial outcomes (e.g., depression) and obesity having a stronger impact on physical health (e.g., hypertension).

Ward's analyses indicated that the pasture-finished steers had a greater proportion of conjugated linoleic acid in their adipose tissue. In another study with lambs a choice of diets with different natural additives (plant secondary compounds) were used to treat a parasite infection for a short period. The reason this work is significant is that it indicates that natural treatments for parasites (i.e. plant secondary compounds) are effective for removing parasites. Thus, for example, if one regime is found to be more environmentally friendly, but less 'healthy', then the magnitude of each effect must be considered and the health effects understood.

Nutrition

Wengreen concluded that the Food Dudes program could not feasibly be implemented into the U.S. school system because of the enormous cost and effort needed to run the program with fidelity. In 2015 their effort focused on the continued development of FIT Game, a school-based intervention designed to address the challenges discovered by our implementation of the Food Dudes, with the goal to develop a low-cost, low-labor, incentive-based approach to increasing elementary school children's fruit and vegetable consumption. In 2015, they expanded the focus of the game to include physical activity and also modified the delivery of the game so that much of the narrative is delivered to children in comic-book style posters in the cafeteria. They found that fruit and vegetable consumption at home did not change during the time that children were playing the Fit Game at school. This information negates the hypothesis that children compensate for eating more fruits and vegetables at school by eating fewer at home. FIT Game 2 produced similar results to previous versions of the game. In this four week study, vegetable intake increased by 32% and vegetable intake increased by 173%.

Norton's research findings generate new insights into the role of stress on Alzheimer's risk. Specific research findings from this project over calendar year 2015 reveal the following results: (1) Influences of the APOE genotype are amenable to mitigation, either through other familial characteristics (history of longevity) or acquired traits (educational achievement); (2) Among persons born during the Great

Depression, individuals who experienced multiple losses of family members to death throughout adulthood were found to have a doubling in risk for Alzheimer's disease; (3) Persons who keep personal journals in adulthood showed a 52% reduction in Alzheimer's risk in late-life; (4) Linguistic complexity from personal journal writings (e.g. larger words, larger vocabulary) is a useful tool to predict cognitive status in late life; (5) Middle-aged participants in a healthy lifestyle program including stress management, reported feeling empowered, learning that lifestyle might impact AD risk, exhibiting positive changes in behaviors associated with brain health; (6) Improvements over six months in stress management, diet quality and moderate physical activity are associated with changes in biomarkers of vascular health and inflammation in middle-aged adults; and (7) Dementia caregiving in a community-based sample of middle-aged adults is associated with lower episodic memory.

Ward notes obesity is associated with low-grade chronic inflammation and linked to insulin resistance, gut permeability, and hepatic steatosis (fatty liver). In mice fed diets with different PUFA contents, the low grade inflammation induced by LPS administration did not affect glucose sensitivity or weight gain compared to mice a low fat or high fat control diets. Plant fat sources do not contain long-chain PUFA, which are known to affect inflammatory processes. At levels typically consumed in the US diet, the n-6 and n-3 fatty acid content had no effect on the metabolic response to a high fat diet.

Gilbertson nearly completed the original aim of attempting to characterize the role of GPR84, a putative medium chain saturated fatty acid (MCFA) receptor, for its role in taste. They continued to follow up on novel data showing that alterations in the long chain fatty acid transduction pathway dramatically affect fat intake, body weight and body fat deposition on a high fat diet. Most surprisingly, however, this effect on high fat diets was only seen in male mice - female mice lacking TrpM5 do not show these differences from their WT littermates.

Hintze concluded that animal studies have now been completed to determine connections between obesity, metabolic inflammation, iron metabolism, polyunsaturated fatty acids (PUFA) and colorectal cancer. They found diets with a n-6 to n-3 PUFA ratio of 1:1 promoted significantly larger tumors in animals compared to animals consuming diets with an n-6:n-3 ratio of 20:1. Results from our study suggest diets with a high n-6:n-3 PUFA ratio have a protective effect against inflammation induced colorectal cancer.

Breeding was completed by Benninghoff to generate all needed mice for the colorectal cancer study to be performed on the F3 generation. A very large set of data was gathered during the study and at necropsy was accomplished to elucidate the effect of dietary treatment on many key parameters, including food intake, energy intake, water intake, mating success, rate of weight gain during pregnancy. The expectation is this analysis to be rather complex given the abundant number of endpoints to be assessed. Preliminary analyses suggest mice consuming the TWD did not experience excess weight gain compared to mice consuming the DIO diet across multiple generations.

Mason induced osteoarthritis (OA) using a common surgical approach, minimally-invasive cranial cruciate ligament desmotomy unilaterally in the sheep stifles to provide traditionally destabilized sheep for treadmill and control groups. Sheep were filmed on a treadmill to permit gait analysis. Preliminary gait analysis demonstrated differences between the peak knee angle (maximal knee abduction or varus angle) for exercised-only sheep (86) compared with surgery + exercise sheep (77) over time. Peak knee range of motion appears to decrease over time (visits) for sheep 86 (about a 10% decline between visit 1 and 5), whereas peak range of motion for sheep 77 appears to be fairly constant until the final visit, where it decreased drastically.

Martini demonstrated specific accomplishments from this objective were the synthesis of interesterified fats. Accomplishments for this objective include the induction in crystallization in the interesterified fats with low content of saturated fats to generate harder and more elastic crystalline networks. This improvement in physical properties of the material was achieved by using of high intensity ultrasound.

Lefevre utilized 29 overweight/obese, (men (N=16) and women (N=13), who were provided two well-controlled diets that were identical in macronutrient content, but differed markedly in flavonoid content. Fecal microbiota composition was substantially changed by dietary flavonoids. In contrast, to the favorable effects on the Firmicutes to Bacteroidetes ratio, Bifidobacterium species were lower on the HFD, which is

generally viewed as being favorable since it is associated with reduced adiposity and associated metabolic dysfunction. Of particular interest was the observation of an increase in Akkermansia muciniphilia with the HFD. This finding is significant given that Akkermansia muciniphilia abundance is negatively correlated with adipocyte inflammation and markers of insulin. The HFD also significantly ($P<0.001$) reduced markers of intestinal inflammation by 26% to 68%. The HFD did not significantly affect serum chemistry (blood urea nitrogen, creatinine, estimated glomerular filtration rate, sodium, potassium, chloride, CO2, calcium, total protein, albumin, globulin, A/G ratio, total bilirubin, alkaline phosphatase, aspartate aminotransferase, alanine aminotransferase). The reduction in the relative abundance Bifidobacterium was associated with a reduction of intestinal eosinophil infiltration. Thus, flavonoid-induced increases in Akkermansia muciniphilia may promote a favorable reduction in intestinal inflammation.

Benninghoff completed the first in vivo study evaluating dietary supplementation with tart cherry powder against development of colorectal cancer in mice consuming an optimal diet versus a Western type diet. Incorporating the TWD in pre-clinical studies allowed for the analysis of the impact dietary bioactives or functional foods on tumor development in a physiological environment that reflects nutritional patterns of the average American. TWD consumption markedly enhanced colitis (40-fold increase in disease activity) and tumor multiplicity (near 6-fold increase) compared with consumption of the optimal AIN93G diet. Supplementation with tart cherry powder caused a significant 40% reduction ($P<0.05$) in tumor incidence in mice fed AIN93G, whereas tart cherries had no effect on tumor incidence in mice fed TWD.

Hintze fed pigs a Western or control diet and fecal samples were collected for gut microbiome analysis. Pigs fed a Western diet, based on American intakes, became obese, diabetic, and have a microbiome that is similar to obese humans.

Lefevre and graduate students completed a pre-clinical study in 72 C57BL/6 mice allocated across 8 diets. Consistent with earlier observations and published reports, the addition of purple corn extracts reduced weight gain on the high fat diets. However, we were not able to replicate earlier findings (obtained at a different institution) of an interaction between background diet composition and purple corn extract in reducing weight gain. Flavonoid intake was also associated with differences in a limited number of biomarkers for insulin sensitivity, intestinal inflammation, and systemic inflammation with flavones and anthocyanins having the greater number of significant associations. Our data are consistent with an overall pattern of negative associations between intakes of catechins, anthocyanins and proanthocyanidins and the relative abundance of Fusobacteria, Actinomycetales and Coriobacteriales taxa previously observed in 94 individuals providing food frequency data. Changes in these affected phyla/families are associated with risk for several disorders including inflammatory bowel disease, obesity, insulin resistance and systemic inflammation. Our results support the hypothesis that changes in intestinal microbiota may serve as the mediating factor for the effects of flavonoids.

Community

Curtis has been assessing the consumer behavior, market coordination and performance of the consumer-oriented fruit and vegetable sector. Consumers attending primarily to purchase fresh produce tend to be married individuals at higher income levels, and those with strong diet/health concerns and supportive of local farming and agriculture open space. Farmers' market shoppers exhibited strong preferences for product quality, freshness, and local origin.

Krannich found general renewable energy attitudes among Utahans are positively related to broad-based environmental value orientations, or "ecological world views," as well as attitudes about global climate change. It is clear that most Utahans do express a "Not in My Back Yard" orientations. Efforts to secure public approval of large-scale wind and solar facility developments will be more likely to succeed if policies and guidelines are implemented to preclude facility siting in very close proximity to or within visual access of areas where residential land uses exist, to limit siting in areas with high value in terms of wildlife habitat and populations, and to maximize local economic benefits such as job creation and tax revenue generation.

Lee investigated how ethnicity is associated with succession planning among African-American, Mexican-American, and Korean-American small business owners. African-American and Mexican-American small business owners were more likely to have succession planning than White business

owners. They discovered that Korean-Americans and Mexican-Americans were more likely than African-Americans and White-Americans to keep their firms until retirement. African-Americans and Mexican-Americans would like to pass their family firms to their children, whereas only 12.6 percent of Korean-Americans would like to transfer their firms. Reallocation of family resources and reallocation of business resources were negatively associated with perceived success. Minority female business owners were more likely to reallocate family resources to help with business tasks and to intertwine both family and business tasks as compared to minority male business owners. Both male and female business owners who operated their businesses from home were more likely to use adjustment strategies. Reallocation of family resources and hiring temporary paid help were positively associated with perceived business success among minority women-owned family firms.

The State was disappointed that a several million dollar project (Baby Steps) produced such dismal gains and decided to move the position of the state training and mentorship coordinator to our "Care About Child" Care program at Utah State University which also included budgetary support. A team of Austin's graduate students evaluated the quality care that young children receiving state subsidies receive, but results were dismal.

Lawver delivered professional development workshops at the Utah Association of Agricultural Education Summer conference in which 25 Utah agriculture teachers participated. She also developed a Safe Participation in Supervised Agricultural Experience (SAE) programs will increase student food security and literacy knowledge. This information will be distributed to secondary agriculture teachers to assist students when assessing their agricultural workplace for risk.

Hofmann completed a paper describing the findings that women comprise an unusually high proportion of recent immigrants in many northern and western areas of the U.S., while men comprise an unusually high proportion of recent immigrants in the Southeast and Midwest. These geographic patterns appear to be largely driven by high numbers of unaccompanied male migrants from Latin America living in Southeastern and Midwestern states. Migration from traditional gateways, from abroad, and between new destinations are heavily male skewed. Migration from low migration states to new destinations is characterized by relatively balanced sex ratios.

Berry conducted research to assess whether disability prevalence in rural areas among non-elderly populations is due to in-migration or to non-out-migration by the disabled. Disability rates vary radically depending on whether physical or other types of impairments are under discussion although 25% of Americans will have some type of disability before reaching retirement age and those in rural places have rates between 5 and 33% higher than those in urban and metro areas.

Success Story: AgrAbility of Utah

Farmers and ranchers facing limitations due to illness, injury, or disability often find it difficult to remain in agriculture. UCES provides education, and technical assistance on modifications and assistive technology devices to help them remain in agriculture. To date AgrAbility has helped over 230 agriculturalists and their families remain in agriculture.

In a regional survey of 1,981 pesticide applicators, Pate identified differences in risk perception and safety consciousness of confined work space tasks among farm workers representing special populations. Differences have been identified among pesticide applicators' use and selection of personal protective equipment. Pesticide applicator survey results suggested factors affect face and eye protection equipment use perceptions differently by Utah regions.

Bradford used qualitative data and demonstrated the utility and importance of the 2-session, brief marriage checkup. The data collected include (a) Skin conductance; (b) Audio-visual recordings of social support and conflict interactions; (c) Self-report data using assessment instruments. Results were shown that those high in attachment anxiety were significantly associated with greater physiological reactivity during the conflict and recovery portions of the study. Clinical implication highlights the importance of assessing for attachment styles when working with couples, and emphasizes the utility of biofeedback devices to facilitate emotional regulation.

Lim conducted an intensive literature review about the timing and patterns as well as outcomes of early family building behaviors. Results indicate that selection does play a role in early marriage. The role of selection in early marriage varies depending on gender. For example, growing up in a single-parent

family increases men's odd of getting married earlier than their counterparts (i.e., the same birth cohort) while early family background does not affect women's timing of first marriage. They found that early marriage is negatively associated with later economic outcomes (both individual and family income at age 45) regardless of gender. However, specific pathways linking early marriage and later family income (at age 45) were not clear.

Lown completed collection of student loan data from online focus groups and from students at six land grant universities. Results generally suggest that (a) students relied heavily on advice from parents, guidance counselors, and friends; (b) attending college was not possible without student loans; and (c) students knew very little about the loans they would be responsible for repaying.

Success Story: Finance

Extension is an integral part of many programs designed especially for low and moderate income families. Programs include Volunteer Income Tax Assistance and the Earned Income Tax Credit; Utah Saves; Home Buyer Education and Individual Development Accounts as well as additional development of the PowerPay debt management and financial education website. The Smart Money Moves class is the first step to getting an Individual Development Account (IDA) in Cache County. In the past decade, a total of 138 families have successfully graduated from the IDA program by saving $1500 and having it matched by $4500 for a home, business, or education. There are currently 89 savers in the program. So far, a total of $211,392.14 has been saved. The matching amount is $628,173.99. The majority of the matched savings has gone to Utah State University for tuition. However, home purchases are also very popular. Before long, the IDA program in Cache County will have added $1,000,000 to the economy of Cache County and Utah. In Weber County, IDA classes reached approximately 107 people. Post survey respondents reported 90% improved their financial decision making and track their expenses more closely. Seventy-nine people taking Home Buying classes were able to close on their new homes in 2015 and save on their down payments--up to $5000 each for total savings of $395,000 for these families.

Success Story: During the 2015 tax season, taxpayers received Volunteer Income Tax Assistance via the Virtual VITA delivery model and the support of their local Extension office. In total the filers received $211,484 in federal and state refunds. It is estimated the taxpayers saved around $40,000 in tax preparation fees. Partly due to training that USU extension has done for the IRS and other interested parties the concept has expanded on a national level. During the 2015 tax season about 30,000 returns were completed following the Virtual VITA model developed in Utah. If the benefits are similar to those seen in Utah it would mean that volunteers at these other locations helped qualifying taxpayers receive $40 million in refunds.

Success Story: Manufacturing Extension Program

This program was developed to assist Utah's small manufacturers to learn and acquire new technologies and processes to help them become more competitive. The manufacturing sector plays a major role in Utah's economy. Small and medium sized manufacturers confront major problems in responding to increasing global competition. These problems encompass a broad range of issues, only some of which relate directly to technology. Inadequate resources - people, money, expertise, information, and insufficient time are reasons many small industrial firms are not improving their manufacturing performance. During 2015 in Utah 64 of 65 companies reported impacts including $44,134,500 in increased sales and retained sales of $54,661,000. Cost savings amounted to $16,672,124. Total investment impact of MEP programming was $56,405,100. There were 757 jobs created or retained through the efforts of MEP.

Success Story: Business, Entrepreneurship, and Rural Economic Development

USU Business Entrepreneurship and Rural Economic Development programs include eight SBA funded Small Business Development Centers at all USU campuses; five Business Resource Centers at Brigham City, Tooele, Moab, Blanding, and Vernal; a Micro-Business Center for refugees and veterans funded by the Department of Workforce Services project with Salt Lake County and Salt Lake Regional Campus; and the Development of Micro-Enterprise and Small Business Development Programs. The Business Resource Centers held successful business and economic development summits providing training for approximately 625 local businesses. All USU Extension SBDC offices hosted ""Utah's Own"" workshops sponsored jointly by USU and Utah Department of Agriculture and Food. Approximately 500

food entrepreneurs and businesses received training in how to uniquely market their products and services at these events. Extension USU SBDC and BRC centers have created an economic impact of $31,837,300 in small business capital infusion, $22,157,440 in sales increase, 125 new business starts, 378 jobs created, and have assisted 1345 largely rural clients in 2015. This Extension network is largely unique to Utah and USU's commitment to applied business and community development. Overall, 3076 clients received training, counseling or other business services as a result of Utah Extension Business and Rural Economic Development Programs in 2015.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	110.0	0.0	65.0	0.0
Actual	90.5	0.0	53.9	0.0

II. Merit Review Process

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

- Internal University Panel
- External University Panel
- External Non-University Panel
- 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 10%-15% of the time.

Utah Cooperative Extension Service: The cooperative extension service merit review process involves a review by the University of Wyoming, University of Arizona, and the University of New Mexico extension services. These institutions will review the program components suggested in each program area utilizing extension faculty qualified as specialists with significant program experience in the area being reviewed. In turn, Utah State University Cooperative Extension Service will review the work from these three institutions.

III. Stakeholder Input

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

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey 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. Non-traditional 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, Interagency Coalitions, community religious leaders, United Way, Utah State Advisory

Boards, Utah Fair Boards, Utah Farm Bureau and Farmers Union Boards, afterschool 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 is important to the general public. Agricultural sustainability, including marketing, weed control, crop management and animal health issues, is 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
1749449	0	2335489	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1749449	0	2335489	0
Actual Matching	1749449	0	2357128	0
Actual All Other	0	0	11933815	0
Total Actual Expended	3498898	0	16626432	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
123	Management and Sustainability of Forest Resources	0%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
202	Plant Genetic Resources	0%		10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		5%	
205	Plant Management Systems	43%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	9%		2%	
213	Weeds Affecting Plants	7%		5%	
215	Biological Control of Pests Affecting Plants	0%		5%	
216	Integrated Pest Management Systems	14%		5%	
301	Reproductive Performance of Animals	0%		12%	
302	Nutrient Utilization in Animals	0%		3%	
304	Animal Genome	0%		20%	
307	Animal Management Systems	27%		5%	
603	Market Economics	0%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	44.0	0.0	13.0	0.0
Actual Paid	23.1	0.0	22.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
447462	0	988351	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
447462	0	993761	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4886088	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 actual 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, youths, 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, landscapers, 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?

In 2015, David Frame conducted invited webinars in January, February, March, and April through eXtension Small and Backyard Flocks Community of Practice. The intent was to reach the audience who raises non-commercial backyard chickens.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	63596	291343	28263	129477

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

Patent Applications Submitted

Year:	2015
Actual:	1

Patents listed

Takemoto, J. Y., Chen, D. "Recombinant non-animal cell for making biliverdin," 13/854,791. (Application: February 4, 2015).

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	53	53

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- No State Defined Output
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of 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
2015	28957

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2015 Agriculture is still important in the U.S. It is a $98.1 billion industry, responsible for 1 in 12 jobs, and only 6.4% of household income is spent for food at home. Farmers, ranchers, and agency personnel, need research based information and technical assistance as they make crop management decisions regarding; varieties, soil fertility, water, weeds, insects, etc. Agriculturist and elected officials look to Utah State University Extension Service to continue provide traditional researched based educational information, and assistance to help them diagnosis problems, find solutions and profitably grow agronomic crops.

What has been done
A total of 293 farmers, ranchers, and individuals interested in alfalfa attended the biannual Utah Alfalfa Symposium. They learned about all aspects of alfalfa, including: GMO testing, insects, hands one herbicide injury identification demonstration, pest management, marketing, etc. Another 120 participated in the pre-conference workshop.

Results
Participants reported a significant gain in knowledge, that they intend to use it, that they believe it will translate into increased profitability, and it will impact a huge number of acres in Utah and surrounding states.

4. Associated Knowledge Areas

KA Code	Knowledge Area

201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
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

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
2015	15812

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Efficient production of field crops and forages is essential to maintaining the economic viability of Utah's agricultural operations. Each year, Utah farmers and ranchers produce commodities that generate nearly $1.5 billion in income, with crop sales accounting for approximately 26% of this value(NASS 2010.) Advances in science and technology have enabled growers to increase the productivity and/or efficiency of their farming operations.

What has been done

The Utah State University Extension Agronomy Program is a state-wide effort to assist farmers and ranchers with crop production practices. Programs focus on the science associated with the management of alfalfa, corn, small grains, pasture, and alternative crops. County Extension Agents provide local agronomy assistance throughout Utah. At the state-wide level Extension Specialists provide technical support for agronomy, economics, entomology, irrigation, plant pathology, soils, weeds, and related topics.

Results

Over the nearly 104,000 acres these growers reported (11.3% of Utah's cropland), that would directly result in $5.8 million in added value annually. The total impact is likely much greater since this figure does not account for growers who have participated in USU Extension agronomy programs in the past who did not attend one of the four surveyed crop schools and information from USU Extension that was passed to growers through a third party (i.e., crop consultants, salespeople, and other growers).

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
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

There are many factors influencing our ability to follow through on the goals set herein. Economic conditions are still somewhat subdued. Stable budgets have occurred as the state's economy continues to adapt to new world economic realities. County-level budgets remain the same over the short term. Competing public priorities (primarily social programs, public health, and particularly prisons) have impacted budgets to CES and UAES. The composition of the state's population continues to change, with a higher immigration and in-migration of Individuals outside traditional groups. This has brought about evolving goals and program areas, particularly with respect to Hispanic and displaced international populations. Technology has changed ways previously thought not possible, with much more being done online in interactive settings. Government regulations and public policy changes have continued to have a significant impact on how many of our stated goals can be achieved. In short, external factors have had a more significant impact on our ability to deliver science-based information than any time in the recent past.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A formal assessment of the combined impact of all Extension agronomy programs at USU occurred through a survey administered in 2014. The Extension Agronomy team consists of five Extension specialists and several county Extension agents at USU. The survey was conducted at four major crop schools located on a north to south gradient in the state (Cache Co., Box Elder Co., Sevier Co., and Iron Co.). The farmers in attendance reported that USU Extension agronomy programs over the past five years helped them increase yield of small grains, corn, and alfalfa (including other forages) by an average of 7.4%, annually. Over approximately 104,000 acres represented by these growers, (just over 11% of Utah's cropland) that directly results in $5.8 million in added value annually, and nearly $10 million per year when considering indirect and induced (off-farm) effects. The total impact is likely much greater since this figure does not account for: 1) growers who have participated in USU Extension agronomy programs in the past but did not attend one of the four surveyed crop schools this year, and 2) information from USU Extension that was passed to growers through a third party (i.e., crop consultants, salespeople, and neighbors).

Key Items of Evaluation

USU Extension agronomy programs helped farmers increase yield of small grains, corn, and alfalfa (including other forages) by an average of 7.4% annually. With over approximately 104,000 acres represented by these growers (just over 11% of Utah's cropland) that directly results in $5.8 million in added value annually, and nearly $10 million per year when considering indirect and induced (off-farm) effects.

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
102	Soil, Plant, Water, Nutrient Relationships	0%		10%	
112	Watershed Protection and Management	22%		10%	
121	Management of Range Resources	18%		5%	
123	Management and Sustainability of Forest Resources	0%		3%	
132	Weather and Climate	0%		15%	
135	Aquatic and Terrestrial Wildlife	25%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
205	Plant Management Systems	14%		15%	
213	Weeds Affecting Plants	7%		5%	
307	Animal Management Systems	0%		10%	
605	Natural Resource and Environmental Economics	14%		7%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	12.0	0.0	13.0	0.0
Actual Paid	13.7	0.0	19.1	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**
264611	0	659812	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
264611	0	665221	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	4521612	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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	10341	254366	13509	332292

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	114	114

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- No State Defined Output
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of 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
2015	15870

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Much of the high quality wildlife-related recreation is associated with privately-owned lands. In the U.S., 2.1 million farmers and ranchers control more than 60 percent of the land base. As such, public wildlife inhabits, and is dependent upon, the habitat resources found on private land. Public and private wildlife management agencies and organizations have implemented programs to encourage landowners and other stakeholders to manage for wildlife and/or allow public hunting or recreational access. Lack of coordination between management agencies and stakeholder concerns about damage caused by wildlife and wildlife users have reduced the overall effectiveness of wildlife management.

What has been done
To address these issues in Utah, USU Extension facilitated the establishment of the Cooperative Wildlife Management Program Unit (CWMU) and a business association to address the needs of participants. The Association consists of over 200 farm and ranch operations encompassing over 2.0 million acres of private rangeland in Utah. Currently about 70% of all registered CWMU's in Utah are a member of the Association. We provide members with information, education, technical support, and policy guidance to enhance wildlife management, recreational opportunities, and alternate income potentials on private land.

Results
In 2015, the Cooperative Wildlife Management Unit program generated an additional $40 million in new revenue for Utah landowners and provided free access to over 6,000 Utah hunters annually to high quality big game hunting opportunities. The program has now grown to incorporate over 2.5 million acres of private rangeland owners and managed by 110 operations. It

includes over 500 landowners.

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
201	Plant Genome, Genetics, and Genetic Mechanisms
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
2015	6502

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increased understanding of soil fertility and salinity helps farmers to efficiently use commercial fertilizers and manure resources to improve crop production, maximize profits and minimize nutrient pollution. Few farmers test soils for nutrient needs. Most use a mix of nutrients designed for the ?average? field

What has been done
A USU Extension agent encouraged soil testing and helped participants interprete the research based recommendations. Thirteen farmers participated, testing 53 fields totaling 1,610 acres.

Results
Farmers saved $56.00 per acre on average by soil testing and not purchasing unneeded nutrients for a total savings of $90,300. By not applying an average of 58 pounds of unneeded nutrients per acre, 47 tons of unnecessary nutrients were kept out of the environment.

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
201	Plant Genome, Genetics, and Genetic Mechanisms
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

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 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
102	Soil, Plant, Water, Nutrient Relationships	0%		10%	
112	Watershed Protection and Management	0%		10%	
121	Management of Range Resources	0%		5%	
123	Management and Sustainability of Forest Resources	0%		3%	
132	Weather and Climate	0%		20%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
205	Plant Management Systems	0%		15%	
213	Weeds Affecting Plants	0%		5%	
307	Animal Management Systems	0%		10%	
402	Engineering Systems and Equipment	80%		0%	
403	Waste Disposal, Recycling, and Reuse	20%		0%	
605	Natural Resource and Environmental Economics	0%		7%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	1.0	0.0	0.4	0.0
Actual Paid	1.2	0.0	0.5	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**
23388	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
23388	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	183523	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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	263	2215	125	1053

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	3	3

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- No State Defined Output
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of 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
2015	17

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
2015	10

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

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 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
608	Community Resource Planning and Development	6%		10%	
702	Requirements and Function of Nutrients and Other Food Components	0%		35%	
703	Nutrition Education and Behavior	10%		5%	
724	Healthy Lifestyle	2%		5%	
801	Individual and Family Resource Management	17%		10%	
802	Human Development and Family Well-Being	9%		5%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	3%		25%	
806	Youth Development	53%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	56.0	0.0	6.2	0.0
Actual Paid	49.4	0.0	7.8	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
954069	0	472290	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
954069	0	477701	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1822028	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?

Paul Hill, Washington County Extension Agent is a member of the eXtension Educational Technology Learning Network which was created to guide Extension professionals on specific projects as they integrate technology with their content. The network openly shares information about effective technology integration projects already in use, connects professionals with peers working on similar projects, and documents efforts for future review.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	131168	462095	347282	1161464

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	24	24

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- No State Defined Output
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of 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
2015	37691

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research shows that many diseases and other health problems have much to do with what we eat, and could possibly be prevented by change in eating and other health habits. Child obesity is on the rise, which will only bring more health problems in the future. Many individuals know of the need to eat more healthfully, but have not translated that need into simple tasks to make it happen. Informing about ways to eat more healthfully to prevent obesity and other diseases, and ways to prepare quick and nutritious meals will empower individuals to make healthier choices.

What has been done
Classes and programs were presented for Master Home Food Preservation, community nutrition classes for diabetes, increasing fruits and vegetables and general nutrition foods. Food safety classes, hand washing and food safety managers tests were also provided. In Washington County networking with community entities provided over 150 homes with better nutritional education.

Results
Over 500 adults reported they gained knowledge and would increase fruits and vegetables in their diets.

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
2015	4104

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research shows that many diseases and other health problems have much to do with what we eat, and could be prevented by change in eating and other health habits. Child obesity is on the rise, which will only bring more health problems in the future. Many individuals know of the need to eat more healthfully, but have not translated that need into simple tasks to make it happen.

What has been done
In Davis, Salt Lake, and Utah County nutrition education was taught through class lecture, food demonstrations, information booths (ie farmer's markets) and related activities to help limited-income and minority populations increase their awareness of nutrition components of food and increase their ability to prepare food for themselves and their families within their food budget and to increase awareness of how to incorporate healthy food practices.

Results
After taking Food Sense classes 80% of participants reported being able to stretch food dollars

through the end of the month compared to 62% before classes; 77% reported usually or always shopping with a list compared to 59% before classes; 82% reported making at least 3 meals at home a week compared to 70% before classes; 73% were more physically active after taking classes compared to 54% before classes; 63% choose whole foods based on MyPlate compared to 63% before; and 71% reported always or usually following food safety guidelines when preparing meals compared to 53% before classes.

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
2015	11791

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In recent years, Utah has ranked among the highest in the number of bankruptcies and mortgage foreclosures. Due to high credit card debt, unemployment, larger homes and cars, and the desire to keep one parent at home with the children, families are experiencing much difficulty in making

ends meet. Residents are in need of educational opportunities that focus on money saving tips and financial management topics.

What has been done
Utah Saves, the Individual Development Account Program, Smart Money Moves, and other finance programs were offered to assist with reversing this disturbing trend. Finance programming for the Latino Community was also offered using curriculum developed in Cache county.

Results
The Smart Money Moves class is the first step to getting an IDA account in Cache County. In the past decade, a total of 138 families have successfully graduated from the IDA program by saving $1500 and having it matched by $4500 for a home, business, or education. There are currently 89 savers in the program. So far, a total of $211,392.14 has been saved. The matching amount is $628,173.99. The majority of the matched savings has gone to Utah State University for tuition. However, home purchases are also very popular. Before long, the IDA program in Cache County will have added $1,000,000 to the economy of Cache County and Utah.

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
2015	6293

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The manufacturing sector plays a major role in Utah's economy. Small and medium sized manufacturers confront major problems in responding to increasing global competition. These problems encompass a broad range of issues, only some of which relate directly to technology. Inadequate resources ? people, money, expertise, information, and insufficient time are reasons that many small industrial firms are not improving their manufacturing performance.

What has been done
Priorities for this program will come from a strategic focus on Utah's small manufacturers and on Utah's supply chain linkages. Priority to service delivery will be given to those objectives that best conform to the mission of the MEP, which is; "To raise the competitiveness, performance, and profitability of Utah's manufacturers".

Results
The following are Impacts for 2015: Number of Companies reporting Impacts = 64 of 65, Sales Increases = $44,134,500, Retained Sales = $54,661,000, Jobs Create/Retained = 757, Cost Savings = $16,672,124 Total Investment = $56,405,100

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

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 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
303	Genetic Improvement of Animals	0%		5%	
311	Animal Diseases	0%		10%	
501	New and Improved Food Processing Technologies	0%		10%	
502	New and Improved Food Products	8%		10%	
504	Home and Commercial Food Service	38%		0%	
701	Nutrient Composition of Food	0%		10%	
702	Requirements and Function of Nutrients and Other Food Components	0%		10%	
704	Nutrition and Hunger in the Population	0%		37%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	0%		5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	54%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	2.0	0.0	2.6	0.0
Actual Paid	3.0	0.0	3.5	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
59919	0	215036	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
59919	0	220445	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	520564	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

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	7804	48454	13681	84943

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	10	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- No State Defined Output
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of 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
2015	12000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a growing disconnect between consumers and food production. While farm to fork movements have focused on the agricultural aspects of food production, there is very little being done to help consumers understand what constitutes "quality" food. Programming is needed to help consumers understand the factors that can affect food quality at both the industrial processing and consumer level. Additionally, information is needed regarding benefits of (and issues with) food processing, and to clarifying the body of regulations that apply to food.

What has been done
Karin Allen, Food Quality and Entrepreneurship Specialist, worked with the Utah State Office of Education and Granite School District to redesign State of Utah Standards for the Foods & Nutrition 1 class, serving an advisory role to a panel of Family Consumer Science teachers. Based on the approved revisions, work continued with a graduate student from the School of Applied Sciences, Technology & Education within the College of Agriculture and Applied Sciences to identify, modify, and/or create curriculum supports for FCS teachers, and to create quick reference guides/resource sheets for each of the approved state standards. As a result of this collaboration, all Foods & Nutrition 1 students (estimated 25,000 in 2016) in Utah will take the National Restaurant Association's food handler test as part of the course, and have the opportunity to receive their food handler's permit at a reduced cost.

Results
As a result of this collaboration, all Foods & Nutrition 1 students (estimated 25,000 in 2016) in Utah will take the National Restaurant Association's food handler test as part of the course, and have the opportunity to receive their food handler's permit at a reduced cost.

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
311	Animal Diseases
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
504	Home and Commercial Food Service
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
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
2015	10021

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
303	Genetic Improvement of Animals
311	Animal Diseases
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
504	Home and Commercial Food Service
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
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

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

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.